INTRODUCTION

TO

CLINICAL MEDICINE

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AN INTRODUCTION

TO

CLINICAL MEDICINE.

SIX LECTURES ON

THE METHOD OF EXAMINING PATIENTS; PERCUSSION; AUSCULTATION; THE USE OF THE MICROSCOPE; AND THE DIAGNOSIS OF SKIN DISEASES.

BY

JOHN HUGHES BENNETT, M.D., F.R.S.E.,

PROFESSOR OF THE INSTITUTES OF MEDICINE AND OF CLINICAL MEDICINE IN THE UNIVERSITY OF EDINBURGH.

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PREFACE.

The following Lectures are republished to facilitate the studies of gentlemen attending the Author's practical instructions in the Clinical Wards of the Royal Infirmary of Edinburgh. In preparing them, however, he has not overlooked the possibility that they may be useful to many who are earnestly endeavouring to overcome the preliminary difficulties of a laborious profession, in other Schools of Medicine.

JOHN HUGHES BENNETT.

Edinburgh, *December* 1852.

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INTRODUCTION TO CLINICAL MEDICINE.

LECTURE I.

METHOD OF EXAMINING PATIENTS.

It is absolutely necessary that an examination of patients at the bed-side should be conducted with order, and according to a well understood plan. I have observed that some students, on being called upon, in their turn, to interrogate a case, have felt great embarrassment, and have been unable to proceed. Others have put their questions, as it were at random, without any apparent object, and wandered from one system of the economy to another, in a vain search for a precise diagnosis, and a rational indication of cure. But continual practice, and the adoption of a certain method, will remove all difficulty. No doubt, the questioning a patient, to arrive at a knowledge of his condition, requires as much skill in the medical practitioner, as examining a witness does in counsel at the bar. They make it an especial study, and you must do so likewise. You should remember that, in proportion as this duty is performed well or ill, is the probability that your opinion of the case may be correct or incorrect; and that, not only will the reputation you hold

among your colleagues greatly depend on your ability in the matter, but that the public itself will promptly give its confidence to him whose interrogations reveal sagacity and talent.

The method of examination differs greatly among practitioners, and must necessarily vary in particular cases. Men of experience gradually form a certain plan of their own, which enables them to arrive at their object more rapidly and securely than that adopted with, perhaps, an equally good result by another. In a clinical class, however, and in order that every one present may follow and understand what is going forward, the method adopted must be uniform. I hold it to be a matter of great importance, that every one standing round the bed should take an equal interest in what is proceeding, and this he cannot do unless he is fully aware of the manner and object of the examination. The plan which appears to me the best, and which we shall follow, is the one I learnt when myself a clinical student in the wards of Professor Rostan, of Paris. Its object is to arrive, as quickly as possible, at a knowledge of the existing condition of the patient, in a way that will insure the examiner that no important organ has been overlooked or escaped notice.

For this purpose, we ascertain, in the first instance, the organ principally affected, and the duration of the disease, by asking two questions, "Where do you feel pain?" and, "How long have you been ill?" Let us suppose that the patient feels pain in the cardiac region, we immediately proceed to examine the heart functionally and physically, and then the circulatory system generally. We next proceed to those organs which usually bear the nearest relation to the one principally affected—say, the respiratory system—and we then examine the lungs functionally and physically. We subsequently interrogate the nervous, digestive, genito-urinary, and integumentary systems. It is a matter of little importance in what order these are examined,—the chief point is, not to neglect any of them. Lastly, we inquire into

the past history of the case, when we shall have arrived at all the information necessary for the formation of a diagnosis.

The following is the arrangement of symptoms and circumstances demanding attention under each of the seven heads into which the examination is divided:—

I. Circulatory System.—*Heart*—Uneasiness or pain; its action and rhythm; situation where the apex beats; extent of dulness determined by percussion; its impulse; murmurs—if abnormal, their character, and the position and direction in which they are heard loudest. *Arterial pulse*—Number of beats in a minute; large or small, strong or feeble, hard or soft, equal or unequal, regular or irregular, intermittent, confused, imperceptible, etc. If an aneurismal swelling exist, its situation, pulsations, extent, and sounds, must be carefully examined. *Venous pulse*—If perceptible, observe position, force, etc.

II.—Respiratory System.—*Larynx and Trachea*—Voice, natural or altered in quality, hoarse, difficulty of speech, aphonia, etc.; if affected, observe condition of epiglottis, tonsils, and pharynx, by means of a spatula. *Lungs*—State of respiration; easy or difficult, quick or slow, equal or unequal, laboured, painful, spasmodic, dyspnœa, etc. Expectoration, trifling or profuse, easy or difficult; its character, thin or inspissated, frothy, mucous, purulent or muco-purulent, rusty, bloody, etc. Hemoptysis; cough, rare or frequent, short or long, painful or not, moist or dry. External form of the chest, unusually rounded or flattened, symmetrical or not, etc. Movements—regular, equal, etc. Resonance, as determined by percussion, increased or diminished, dulness, cracked-pot sound, etc. Sounds determined by auscultation, if abnormal, their character and position.

III. Nervous System.—*Brain*—Intelligence—aug-

mented, perverted, or diminished; delirium, stupidity, monomania, idiocy; sleep, stupor, coma. *Spinal cord and nerves*—General sensibility, increased, diminished, or absent; special sensibility—sight, hearing, smell, taste, touch, their increase, perversion, or diminution; spinal irritation, as determined by percussion; motion, natural or perverted, fatigue, pain on movement; trembling, convulsions, contractions, rigidity, paralysis.

IV. Digestive System.—*Mouth*—Teeth and gums. *Tongue*—Mode of protrusion, colour, furred, coated, fissured, condition of papillæ, moist or dry. *Pharynx and œsophagus*—Deglutition—if impeded, examine the pharynx with a spatula, the cervical glands, neck, etc. *Stomach*—Appetite, thirst, epigastric uneasiness or pain, swelling, nausea, vomiting, character of matters vomited, borborygmi, flatuosity, eructations. *Abdomen*—Pain, distension or collapse, tumours, constipation, diarrhœa, character of dejections, hemorrhoids. *Liver*—Size, as determined by percussion, pain, jaundice. *Spleen*—Size, as determined by percussion. If enlarged, examine blood microscopically.

V. Genito-Urinary System.—*Uterus*—Condition of menstrual discharge, amenorrhœa, dysmenorrhœa, menorrhagia, leucorrhœa, etc. If pain, or much leucorrhœal discharge, examine os uteri and vagina with speculum; uterine or ovarian tumours. *Kidney*—Lumbar pain; quantity and quality of urine, colour, specific gravity; precipitates, as determined by the microscope, and by chemical tests; action of heat; nitric acid, etc.; action on test papers; stricture.

VI.—Integumentary System.—External surface generally; obesity; emaciation; colour; rough or smooth; dry or moist; sweats; eruptions (see diagnosis of skin diseases, Lecture VI.); temperature; morbid growths or swelling: anasarca; emphysema, etc.

VII. Antecedent History.—Age; constitution; hereditary disposition; trade or profession; place of residence; mode of living as regards food; epidemics and endemics; contagion and infection; exposure to heat, cold, or moisture; irregularities in diet; commencement of the disease; rigors.

Such are the principal points to which your attention should be directed during the examination of a case. A little practice will soon impress them on your memory, and in this manner habit will insure you that no very important circumstance has been overlooked. At first, indeed, it may appear to you that such a minute examination is unnecessary; but we shall have abundant opportunities of proving that, whilst a little extra trouble never does harm, omission of any part frequently leads to error. It is surprising, also, how rapidly one thoroughly conversant with the plan, is able to examine a patient so as to satisfy himself that all the organs and functions have been carefully interrogated. Remember that the importance of particular symptoms is not known to the patient, and that, consequently, it is not in his power voluntarily to inform you of the necessary particulars. It is always your duty to discover them.

In carrying out the examination, the following hints may be attended to:—

1. It should never be forgotten that you are examining a fellow-creature, who possesses the same sensitiveness to pain and the same feelings as you do, and that everything that can increase the one or wound the other should be most carefully avoided. Prudence, kindness, and delicacy, are especially enjoined upon those who treat the sick.

2. The questions should be precise, simple, and readily comprehended. When an individual has a limited intelligence, or is accustomed to a particular dialect, you will not arrive at your object by becoming impatient, or talking in a loud voice, but by putting your interrogations in a clear

manner, and in language proportioned to the intelligence of the individual.

3. It is often necessary, after asking the first question, "Where do you feel pain?" to tell the patient to put his or her hand on the part. An Irish peasant applies the term "heart" to an indefinite region, extending over great part of the chest and abdomen; and a woman, in speaking of pain in the stomach, often means the lower part of the abdomen.

4. When pain is referred to any circumscribed part of the surface, the part should always be examined by palpation, and, if possible, seen. Rostan relates very instructive cases where the omission of one or the other of these rules has led to curious errors in diagnosis.

5. Although the question, "How long have you been ill?" is sufficiently plain, it is often difficult to determine the period of commencement of many diseases. In acute inflammatory or febrile disorders, we generally count from the first rigor. In chronic affections, a lengthened cross-examination is frequently necessary to arrive at the truth.

6. A state of fever may be said to exist when we find the pulse accelerated, the skin hot, the tongue furred, unusual thirst, and headache. These symptoms are commonly preceded by a period of indisposition, varying in duration, and ushered in by a rigor or sensation of cold. Such a febrile state may be idiopathic, when the case is called one of fever, or symptomatic of some local disease, when the nature of the case is determined by the organ affected and lesion present.

7. In endeavouring to ascertain the cause of the disease, great tact and skill in examination are necessary. We must guard ourselves against the preconceived views of the patient on the one hand, and be alive to the possibility of imposition on the other. Sometimes, with all our endeavours, no appreciable cause can be discovered; and at others we find a variety of circumstances, any one of which would be sufficient to occasion the malady.

8. In forming our diagnosis,—that is, in framing a theory

deduced from the facts elicited by examination,—we should be guided by *all* the circumstances of the case, and be very careful that these are fully known before we hazard an opinion. Even then it is not always possible to come to a satisfactory conclusion, and in such cases the diagnosis should be deferred until further observation has thrown new light upon the nature of the disease.

9. In recording a case, it is, for the most part, only necessary to put down, under each head, the symptoms or signs present. If any system be quite healthy, it should be said that it is normal. In many cases, however, it is necessary to state what are called negative symptoms. This demands great tact, and exhibits a high degree of medical information. For instance, an attack of epilepsy generally commences with a cry or scream; but sometimes there is none,—when this should be stated. Symptoms which are usually present in the disease, but are absent in the particular case, constitute negative symptoms.

10. All mention of size should be, according to its exact measurement, in feet and inches. Extent should be determined by proximity to well-known fixed points. All vague statements, such as large, great, small, little, etc., should be carefully avoided; and in recording cases, dates and references should always be given in the day of the month, and not in the day of the week.

11. In conversing on, or discussing, the circumstances of the case at the bed-side, we should always use technical language. Thus, instead of saying, a man has a cavern at the top of the lung, we should speak of a vomica under the clavicle; instead of saying, a man has diseased heart, we should speak of cardiac hypertrophy, or of insufficiency of the mitral or aortic valves, etc.

Having formed a diagnosis, and prescribed for the patient, the further examination should be conducted at intervals, varying, as regards time, according to the gravity of the case. In addition to the changes which may occur in the

signs and symptoms previously noticed, the effects of remedies should be carefully inquired into. Whenever a record of the case is to be kept, I cannot too strongly impress upon you the importance of noting these down in a book at the time, rather than trusting to the memory. For a long series of years the reports of cases, dictated aloud by the professor, and written down at the bed-side by the clerk, has formed a leading feature of the Edinburgh system of clinical instruction, and constitutes the only trustworthy method of drawing up cases with accuracy.

When a patient dies, the examination is not completed. The time has now arrived when an inspection of the dead body confirms or nullifies the diagnosis of the observer. You should consider this as a most important part of the clinical course. It is invariably regarded with the greatest interest by those who practise their profession with skill. It is only in this manner that any errors they may have committed can be corrected; that the value of physical diagnosis can be demonstrated and properly appreciated, and the true nature or pathology of diseases, and the mode of treating them rationally, can ever be discovered.

But here, again, method and order are as necessary in the examination of the dead as of the living, and it is of equal importance that no viscus be overlooked. The three great cavities should always be investigated. Nothing is more injurious to the scientific progress of medicine than the habit of inspecting only one of them, to satisfy the curiosity of the practitioner, or to determine his doubts on this or that point. Many medical men direct their attention to a certain class of diseases, and are apt to attribute too much importance to a particular lesion. It has frequently happened to me, when pathologist to this institution, to observe, that after the physician has examined this or that organ, to which he has attributed the death of his patient, and left the theatre, that further examination, according to the routine I always prac-

tised, has revealed important lesions that were never suspected. Thus, a person supposed to die of Bright's disease of the kidney, may have a pneumonia that was latent and overlooked. Large caverns and tubercular deposits in the lungs may satisfy the physician, and he may leave the body, when intense peritonitis may be subsequently found, arising from intestinal perforation. A man has hypertrophy, with valvular disease of the heart; he dies suddenly, and everything is referred to the cardiac lesion. On opening the head, an apoplectic extravasation or yellow softening may be discovered. I cannot too strongly, therefore, impress upon you the necessity of always making a thorough *post-mortem* examination, and for this purpose you should, if possible, obtain permission to inspect the body, and not any particular cavity.

The object of a post-mortem examination is threefold,—1st, the cause of death; 2d, an appreciation of the signs and symptoms; 3d, the nature of the disease. These inquiries are very distinct, but practitioners generally have only in view the two first. It frequently happens that, on the discovery of a lesion that seems to explain the fatal termination, they feel satisfied, and there is an end to the investigation. In medico-legal cases, this is the only object. But even here it is necessary to examine all the organs, to avoid a possibility of error, for how can any conscientious man form an opinion, that an abdominal disease has been fatal, if he be not satisfied by inspection that the chest and brain are healthy? Again, it often occurs that a particular sign or sympton is unusual or mysterious, and this, if explained by the examination, is sufficient for the practitioner. But it must be obvious that this throws no light upon the nature of the disease, or its mode of cure. To do this, morbid changes must be sought for, not in that advanced stage where they cause death, or occasion prominent symptoms, but at the very earliest period that can be detected. Hence we must call in the microscope to our assistance, and with its aid follow the lesion into the ultimate tissue of organs; we must observe the circumstances

which produced it, as well as the symptoms and physical signs to which it gives rise, the secondary disorders, and the order of their sequence; their duration and mode of termination. This is the kind of extended investigation which can alone be serviceable to the advancement of medicine, and such, I trust, will be the object all of you will have in view, in examining dead bodies. At all events, such are the views that I shall constantly endeavour to place before you during this course of clinical instruction.

The following is an arrangement of the organs, textures, etc., which demand your attention:—

I. External Appearances.—Number of hours after death. General aspect and condition of the body. In cases of suspected death by violence great minuteness in the external examination is necessary.

II. Head.—Scalp; calvarium; meninges; sinuses; choroid plexus; brain, its form and weight; cerebellum, its weight; cortical and medullary substance of brain; ventricles, exact quantity of fluid in each, which should be removed with a pipette, its character; nerves, and arteries at the base of the brain; sinuses.

III. Spinal Column.—Vertebræ; Meninges; Cord; Nerves.

IV. Neck.—Thyroid gland; larynx and its appendages; trachæa; tonsils; pharynx; œsophagus.

V. Chest.—Thymus gland; lining membrane of bronchi; bronchial glands; pleuræ; parenchyma of lungs; large thoracic veins; pericardium; general aspect and position of the heart; its weight; right auricle; coronary veins; auricular septum; right ventricle, size of its cavity; thickness and degree of firmness of its walls; endocardium; tricuspid valve; pulmonary artery, its caliber; pulmonary veins; left auricle; mitral valve; left ventricle; thickness and condition of its muscular tissue; size of its cavity; sigmoid valves; coronary arteries; thoracic aorta, its structure and caliber.

VI. ABDOMEN.—Peritoneum and peritoneal cavity; position of abdominal viscera; stomach; duodenum; small and large intestines; liver, its weight, form, and structure—its artery, veins, and ducts; gall-bladder and its contents; portal system; pancreas and its duct; mesenteric and other absorbent glands; spleen, its weight, size, and structure; supra-renal capsules; kidneys, weight of each; secreting and excreting portions; pelvis; ureters; bladder, with the prostate and urethra in the male; in the female, uterus, ovaries, Fallopian tubes, vagina; abdominal aorta and vena cava; ganglia of the sympathetic system.

VII. BLOOD.—Appearance in the cavities of the heart, in aorta, vena cava, vena portæ, etc.

VIII.—MICROSCOPIC EXAMINATION of all the morbid structures and fluids, the blood, etc., etc.

In carrying out the post-mortem examination, the following hints may be attended to:—

1. As I have already said, the head, chest, and abdomen should always be examined, but the spinal cord and neck need not be disturbed unless the symptoms indicate some lesion there.

2. Great care should be taken never to disfigure the body. Incisions through the skin, therefore, should be made in such directions that when the edges are afterwards sewn together, the necessary dissections below may not be visible. Neither should the body be exposed more than is needful, and delicacy demands that the genitals should always be kept covered. The wishes and feelings of the friends and relations should invariably be held in consideration.

3. You should seize every opportunity of opening dead bodies with your own hands, and acquiring dexterity in exposing the cavities, taking out the viscera, etc. Nothing is more painful than to see the brain cut into or contused, in removing the calvarium; or the large vessels at the root of the neck wounded in disarticulating the sternum, so that the

surrounding parts are deluged with blood; or the cardiac valves cut through, instead of being simply exposed; or awkward incisions made into the intestines, whereby fæces escape; slipping of ligatures, etc, etc. Coolness, method, knowledge of anatomy, and skilfulness in dissection, are as necessary when operating on the dead as on the living body.

4. In examinations made at private houses, it is not always necessary to remove the viscera. The heart, lungs, liver, kidneys, etc, may be readily examined *in situ*. But in this Infirmary, where every facility exists, the viscera are invariably taken out, and after describing the morbid alterations they present, I shall always pass them round, so that every one present may examine them.

5. It is a good rule never to omit the examination of a morbid texture or product microscopically, until experience has made you perfectly familiar with its minute structure. This is generally done by the pathologist immediately after the examination.

6. Notes of the examination should always be made at the time. If organs are healthy, this should be distinctly stated, so that hereafter all doubt as to their having been carefully examined may be removed. Here negative appearances are often of as much consequence as negative symptoms.

7. In describing morbid appearances, we should be careful to state the physical properties of an organ or texture, such as the size, form, weight, density, colour, position, etc.; and avoid all theoretical language, such as its being inflamed, tubercular, or cancerous, as well as such indefinite description as small and large, narrow and wide, increased or diminished, etc. etc. Size should always be stated in feet and inches, and the amount of fluid in quarts, pints, or ounces.

During the examination of a patient in the manner described, it will be found necessary to employ three modes of

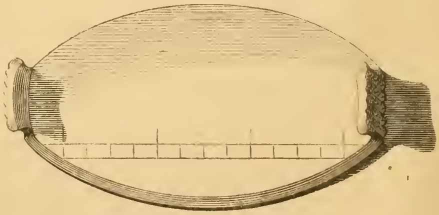
proceeding that require more especial attention than I have given to them in the foregoing summary. These are percussion, auscultation, and the use of the microscope. I propose, then, giving you a short account of each of these methods of exploration.

LECTURE II.

PERCUSSION.

The object of percussion is to ascertain the density and size of organs. It may be practised directly, or through the medium of an interposed body (mediate percussion). Without knowing how to strike, and to produce clear tones, we can never educate the ear, or the sense of resistance. This preliminary part in the art of percussion, requires a certain dexterity, which some find it very difficult to obtain. The difficulty seems to depend, in some cases, on a deficiency in the proportions usually existing between the length of the fingers. Thus, I have seen more than one person who had the index finger nearly an inch shorter than the middle one, and who,

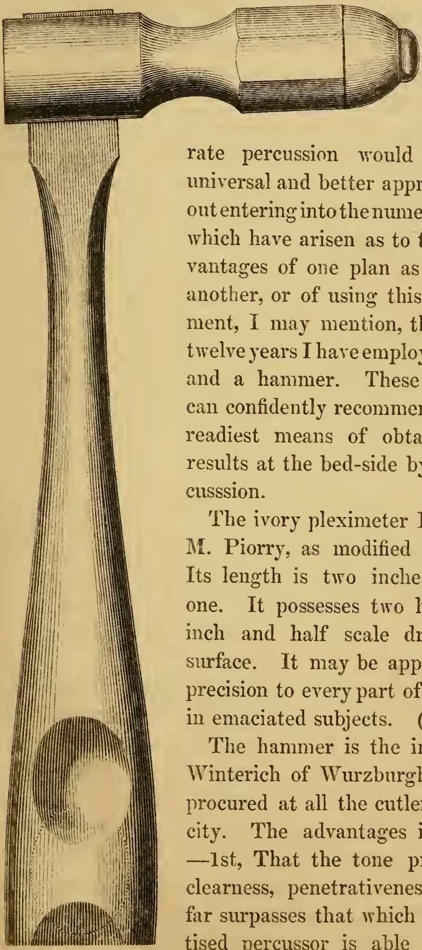
Fig. 1.



consequently, found it impossible to strike the pleximeter fairly with the tips of two fingers at once. By far the most common case of failure, however, is want of patience

and perseverance to overcome the first mechanical difficulties; and there is every reason to believe that could this be surmounted, accurate percussion would become more universal and better appreciated. Without entering into the numerous discussions which have arisen as to the superior advantages of one plan as compared with another, or of using this or that instrument, I may mention, that for the last twelve years I have employed a pleximeter and a hammer. These instruments I can confidently recommend to you as the readiest means of obtaining accurate results at the bed-side by means of percusssion.

Fig. 2.



The ivory pleximeter I use is that of M. Piorry, as modified by M. Mailliot. Its length is two inches, and breadth one. It possesses two handles, and an inch and half scale drawn upon the surface. It may be applied with great precision to every part of the chest, even in emaciated subjects. (Fig. 1.)

The hammer is the invention of Dr Winterich of Wurzburgh, and may be procured at all the cutlers' shops in this city. The advantages it possesses are —1st, That the tone produced, in its clearness, penetrativeness, and quality, far surpasses that which the most practised percussor is able to occasion by

other means. 2d, It is especially useful in clinical instruction, as the most distant student is enabled to distinguish the varieties of tone with the greatest ease. 3d, It at once enables those to percuss, who, from peculiar formation of the fingers, want of opportunity, time, practice, etc., are deficient in the necessary dexterity.

With the assistance of the instruments I now recommend to you, every student acquainted with the relative situations of the different thoracic and abdominal organs, is himself enabled, without other preliminary education, to detect the different degrees of sonoriety they possess in a state of health and disease. I may say, that by means of these instruments, after one hour's practice on a dead body, he is placed on a par (as regards the art of percussion) with the generality of experienced practitioners in this country; and any of you, after one month's employment of them, will be enabled to mark out accurately on the surface of the body, the size and form of the heart, liver, spleen, etc.

OF THE DIFFERENT SOUNDS PRODUCED BY PERCUSSION.

The sounds produced by percussion arise from the vibrations occasioned in the solid textures of the organ percussed. The different density and elasticity of these textures will of course more or less modify the number and continuance of the vibrations, and give rise to different sounds.

M. Piorry considers that nine elementary sounds are thus formed, which he has designated, from the organ or part which originates them, "*femoral, jecoral, cardial, pulmonal, intestinal, stomacal, osteal, humorique*, and *hydatique*." I consider that all these sounds may be reduced to three elementary ones; that, in point of fact, there are only three tones occasioned by percussion, and that all the others are intermediate. These three tones are respectively dependent, —1st, on the organ containing air; 2d, on its containing fluid; and, 3d, on its being formed of a dense uniform paren-

chymatous tissue throughout. These tones, therefore, may be termed the *tympanitic*, the *humoral*, and the *parenchymatous*. Percussion over the stomach gives the best example of the first kind of sound; over the distended bladder, of the second; and over the liver, of the third. Certain combinations of these sounds occasion the *metallic* and the *cracked-pot* sound. The terms jecoral, cardial, pulmonal, intestinal, and stomacal, however, may be used to express those modifications of sound produced in percussing respectively the liver, heart, lungs, intestines, and stomach.

No description will suffice to convey proper ideas of the various modifications of tone occasioned by percussing over the different thoracic and abdominal viscera. To become acquainted with these, it is absolutely necessary to apply the pleximeter to the body, and then half an hour's practice with this instrument and the hammer will be sufficient to render any one conversant with those which may be heard in a normal state.

It must be remembered, however, that the tones even then may vary according to circumstances. Thus, immediately after a deep inspiration, the pulmonal sound will be rendered more tympanitic, and, after expiration, more parenchymatous. In the same manner, the stomach and intestines may give out different sounds according as they are more or less full of contents. In the left or right iliac fossa a clear tympanitic sound will be heard when the intestine below is empty, and a dull parenchymatous sound when it is full of fæces.

A study of the different modifications of sound, which various organs thus produce in a state of health, readily leads to the comprehension of the sounds which may be elicited in a morbid state. Thus, the lungs may occasion a dull or parenchymatous sound, from solidification, the result of exudation, or, on the other hand, become more tympanitic, from the presence of emphysema. The abdomen may give out a parenchymatous sound, from enlargement of the uterus or an ovarian tumour; or a humoral sound, from the effusion of fluid in the cavity of the peritoneum.

OF THE SENSE OF RESISTANCE PRODUCED BY PERCUSSION.

By the sense of resistance is understood the peculiar sensation resulting from those impressions which are communicated to the fingers on striking hard, soft, or elastic bodies. It is of the greatest service in determining the physical condition of the organ percussed. The sense of resistance bears relation to the density of the object struck,—hence firm and solid textures offer more resistance than those which are soft or elastic. Of all the thoracic and abdominal organs, the liver presents the greatest degree of resistance, and the stomach the least. The presence of fluid in the hollow viscera, offers a medium of resistance between the parenchymatous organs on the one hand, and those containing air on the other. But air much condensed, or fluid contained within the rigid walls of the thorax, may offer a considerable degree of resistance.

The sense of resistance should be as much educated by the physician as the sense of hearing, and it would be difficult for an individual, practised in the art of percussion, to say which of these two points is the more valuable to him. Both are only to be learnt by practice, and considering it perfectly useless to describe that in words which may be learnt in half an hour, by the use of the pleximeter and hammer on a dead body, or the living subject, I shall now proceed to describe the

GENERAL RULES TO BE FOLLOWED IN THE PRACTICE OF MEDIATE PERCUSSION.

1. The pleximeter should be held by the projecting handles between the thumb and index finger of the left hand, and pressed firmly down upon the organ to be percussed. Much depends upon this rule being followed, as the sound and sense of resistance are considerably modified according to the pressure made by the pleximeter. A very easy experiment will prove this. If, for instance, the pleximeter be struck while

it rests lightly on the abdomen over the umbilicus, and again, when it is pressed firmly down amongst the viscera, the change in tone will be at once perceived. In the first case, a dull sound is produced, from the muscles and integuments being alone influenced by the force of the blow; in the second case, a clear tympanitic sound is occasioned from the vibration of the walls of the intestine. In every instance, therefore, the pleximeter should be so held and pressed down, as to render it, so to speak, a part of the organ we wish to percuss.

2. Great care must be taken that no inequality exist between the inferior surface of the pleximeter and the skin. Firmly pressing it down will always obviate this when the abdomen is examined. As regards the thorax, the groove over the anterior mediastinum, the prominence of the clavicles and of the ribs, in emaciated subjects, may allow a hollow to exist under the instrument, by which a deceptive tympanitic sound is occasioned. By a little management, however, with the small and oval pleximeter I have recommended, this may readily be avoided.

3. The hammer should be held, as advised by Dr Winterich, between the thumb and the first and third fingers, the extremities of which are to be placed in hollows prepared for them in the handle of the instrument. By some these are considered useless, but in all cases where slight differences in tone are to be appreciated, I have found this the best mode of employing it. Ordinarily, however, it will be sufficient to hold it by the extremity of the handle, merely in such a manner as will enable the practitioner to strike the pleximeter lightly, or with force, as occasion may require.

4. Care must be taken to strike the pleximeter fairly and perpendicularly. Unless this be done, vibrations are communicated to textures in the neighbourhood of the organ to be percussed, and fallacious results are the consequence. If in percussing the lungs, for example, the blow be made obliquely, we obtain the dull sound produced by the rib, and I have seen considerable error in the diagnosis thus occasioned.

5. A strong or gentle stroke with the hammer will modify the tone and sense of resistance, inasmuch as the impulse may be communicated by one or the other to a deep-seated or a superficial organ. Thus a gentle stroke will elicit a pulmonal tympanitic sound just below the fourth rib, where a thin layer of lung covers the liver, but a strong one will cause a jecoral parenchymatous sound. At the inferior margin of the liver, on the other hand, where a thin layer of the organ covers the intestines, the reverse of this takes place, a gentle stroke occasioning a dull, and a strong one a clear sound.

6. By withdrawing the hammer immediately after the blow, we are better able to judge of the sound; by allowing it to remain a moment, we can judge better of the sense of resistance.

7. The integuments should not be stretched over the part percussed, as when the stethoscope is employed, for an unnatural degree of resistance is thus communicated to the hand of the operator from the muscular tension. In every case, especially where the abdomen is examined, the integuments and superficial muscles should be rendered as flaccid as possible.

8. It is always best to percuss on the naked skin. It is not absolutely essential, however; and in cases where, from motives of delicacy, it is desirable that the chest or abdomen be not exposed, it only becomes necessary that the covering of linen or flannel be of equal thickness throughout, and not thrown into folds.

9. The position in which the individual examined should be placed, will vary according to the organ explored. In percussing the thoracic organs and the liver, a sitting position is most convenient. The stomach, intestines, uterus, bladder, and abdominal tumours or effusions, are best examined when the patient is lying on the back, with the knees flexed so as to relax the abdominal walls, and, if necessary, the head and neck bent forward, and supported by pillows. In percussing the spleen, the individual should lie on the right side; and when the kidneys are examined, he should lie on the breast

and abdomen. In cases of effusion into the serous cavities, a change of position furnishes most valuable indications.

10. In percussing any particular organ, the pleximeter should be first applied over its centre, where the sound and sense of resistance it may furnish, are most characteristic. Two blows with the hammer are generally sufficient to determine this. From the centre, the pleximeter should be moved gradually towards the periphery, or margin of the organ, and struck as it proceeds with the hammer, now forcibly, now lightly, until the characteristic sound of the next organ be elicited. The pleximeter is then gradually to be returned towards the organ under examination, until the difference of tone and sense of resistance become manifest. In this manner having first heard the two distinct sounds well characterised, we shall be better enabled to determine with accuracy, the limit between the one and the other. This may be done exactly after having determined whereabouts the line of separation is, by placing the long diameter of the pleximeter transversely across it, and striking, first one end of the instrument, and then the other, till the precise spot is determined. This spot should now be marked, by placing with a pen a dot of ink on the skin. The opposite and then other portions of the margin of the organ should be limited in the same manner, and these in turn should be marked with dots of ink, until the whole organ be completely examined. Then by uniting all these dots with a line of ink, we have the exact form of the organ drawn upon the skin. When it is thought necessary to render the first mark permanent, in order to see if any subsequent change take place in the size of the organ, or extent of the dulness, it may be rendered so, by carrying lightly a stick of argent. nit. over the ink line, while it is still moist.

SPECIAL RULES TO BE FOLLOWED IN PERCUSSING PARTICULAR ORGANS.

The short rules and practical remarks about to be given,

are derived partly from the precepts of M. Piorry, as I have heard him deliver them in the wards of La Pitié, and partly from my own experience.

Lungs.—Percussion of the lungs generally bears reference to a change in density, which is only to be detected by comparing the healthy with the morbid portions. The great practical rule here to be followed is, to apply the pleximeter to both sides of the chest in succession, with the same firmness, exactly in the same situation, and let the blow with the hammer be given with the same force. Care must be taken that the position of both arms be alike, as the contraction of the pectoral muscles on one side more than on the other may induce error. In short, every circumstance must be the same before it is possible to determine, in delicate cases, either from the tone or sense of resistance, whether change of density exist in the lungs. When circumscribed alterations are discovered in the pulmonary tissue, their limits may be marked out on the surface of the skin, in the manner previously indicated. In this way I have frequently succeeded in determining with accuracy the size and form of circumscribed indurations, arising from partial pneumonia and pulmonary apoplexy. Under the clavicles, the pleximeter must be applied with great firmness. Inferiorly, a thin layer of lung lies over the superior surface of the liver; and to determine the exact place where its inferior border terminates, the blows with the hammer should be very slight. Posteriorly, also, the pleximeter must be firmly applied, and the force of the blows considerable; but they should decrease in force inferiorly, where a thin layer of lung descends over the liver much deeper than anteriorly.

In a healthy state, a distinct difference may be observed in the sonoriety of the lungs immediately after a full expiration and a full inspiration. This does not take place when the tissue becomes indurated from any cause; and thus we are furnished with a valuable diagnostic sign. Congestion of the

lung, and pneumonia in its first stage, cause only slight dulness and increased resistance, which, however, are readily detected by the practised percussor. In the second and third stage of pneumonia, and in apoplexy of the lung, this dulness and resistance are well-marked, and even an impression of hardness and solidity communicated to the hand. When, however, the lung is studded with tubercles, the induration is most intense, and the greatest degree of resistance communicated.

Partial indurations from apoplexy, or simple cancerous and tubercular exudation, may be detected by percussion, even when deep-seated and covered by healthy portions of the lungs. In this case, by pressing with the pleximeter, and striking lightly, a tympanitic sound only is heard; but by pressing the pleximeter down firmly, and striking with force, the dull sound may be elicited and circumscribed. When indurations, however, exist inferiorly in those portions of the lungs which overlap the liver, it requires great practice to detect them with certainty. Caverns in the lungs, when large and filled with air, induce a tympanitic sound; but they are generally more or less full of viscous and fluid matters, and give rise to dulness.

Two or three ounces of fluid may be detected in the pleural cavity, by causing the patient to sit up. The height or level of the fluid is readily determined, and should be marked daily by a line made with nitrate of silver. If the effusion be only on one side, the increased dulness is more easily detected. It disappears on placing the patient in such a position as will cause the fluid to accumulate in another part of the pleural cavity, when the space which was previously dull becomes clear. When the effusion entirely fills the pleural cavity, no limit, of course, can be detected; but, even then, the dulness is distinguished from that of the liver by the diminished feeling of resistance.

When air is effused into the pleura, the sound is like that of a drum, and readily detected.

Heart.—To mark out the precise limits of the heart, constitutes the first difficult lesson in the art of percussion. M. Piorry commences by determining the clear sound at the upper end of the sternum, and bringing the pleximeter gradually downwards till the dull sound of the heart be heard. I have found it best to place the instrument first under the left nipple, where the cardial dulness is most intense; then to draw it upwards, striking it continually with the hammer until the clear sound of the lung be elicited; then, by bringing it down again towards the heart, we shall readily distinguish the line where cardial dulness commences, and thus limit the superior margin of the organ. The same method is to be followed in determining the situation of the lateral margins, only drawing the pleximeter outwards or inwards, striking more and more forcibly with the hammer, until the clear tympanitic sound of the lung only be heard. It is more difficult to determine the situation of the apex of the heart; for as this rests on the diaphragm, and this again upon the left lobe of the liver, it cannot readily be distinguished from them. The size of the heart, however, may be pretty accurately estimated, by limiting its superior and lateral margins. In females, the left mammary gland should be drawn upwards and outwards by an assistant.

The normal size of the heart differs in different persons. As a general rule, however, it may be considered that, if the transverse diameter of the dulness measure more than two inches, it is abnormally enlarged. It has been known to measure seven inches. (Piorry.) In hydropericardium, the dulness has been remarked to exist rather at the superior part of the sternum, than on one side or the other. (Piorry, Reynaud.) In hypertrophy and dilatation of the right ventricle, the increased extent of the dulness stretches towards the median line, and sometimes passes over it. In similar hypertrophy of the left ventricle, the dulness extends on the left side more or less, according to the increased size

of the heart. In concentric hypertrophy, there is little or no enlargement, but the density is greatly increased, which is readily detected by the feeling of resistance.

The presence of tubercles in the lungs surrounding the heart; aneurisms or other tumours pressing upon, or in the neighbourhood of, the organ; hypertrophied liver, extensive empyema, etc. etc., may render its mensuration difficult or impossible.

Liver.—Limitation of the size of the liver should be commenced by placing the pleximeter over the organ on the right side, where the dulness and resistance are greatest. It should then be carried upwards, until the clear sound of the lung be distinguished, when it ought again to be brought down, and the limit marked. This limit, however, may indicate either the inferior margin of the lung, or superior convex surface of the liver. Now, as a thin layer of lung descends in front of the liver, it will be necessary to determine where the tympanitic sound ceases inferiorly, by striking gently with the hammer, and where the parenchymatous sound ceases superiorly by striking forcibly, so that vibrations may be communicated to the organ through the layer of lung. The space between these two lines thus marked on the surface is wider in some individuals than in others, and deeper and more extensive posteriorly than anteriorly. By carrying the pleximeter from the right side anteriorly, and then posteriorly towards the left of the patient, the whole superior margin may be thus detected, and marked with ink upon the surface, except where the liver comes in contact, through the medium of the diaphragm, with the apex of the heart. The inferior margin is for the most part readily detected. It must be remembered, however, that in the same manner as a thin layer of lung covers the upper margin, so a thin layer of liver descends on the right side over the intestine. It is, therefore, necessary to be cautious in determining the inferior margins, for a tolerably strong blow

with the hammer will give rise to a tympanitic sound from the intestine, heard through the liver. The lower margin must be percussed in an inverse manner to the superior, and as we proceed downwards the force of the blow should be diminished. The inferior margin of the liver is in general readily detected, from the contrast which its dulness and density, produced on percussion present, contrasted with the tympanitic and elastic feel of the intestines and stomach.

The superior limit of this organ is generally found about two inches below the right nipple, or corresponding with the fifth rib. Its inferior border descends to the lower margin of the ribs. The extent of the jecoral dulness in the healthy state is in general two inches on the left side, three inches in the hepatic region anteriorly, and four inches in the hepatic region laterally. (Piorry.)

Variations in the size of the liver, from congestion, inflammation, abscesses, hydatids, tumours, atrophy, etc., etc., may often be exactly determined by means of percussion. In icterus, the increase and diminution of this organ, as evinced by lines marked on the skin, will generally be found to bear a proportion to the intensity of the disease. When tumours are present, the inferior border often presents an irregular form. If the inferior lobes of the lung be indurated by tubercles or hepatisation, it becomes difficult or impossible to draw the limit between them and the liver. When fluid effusion exists in the pleura, the increased density of the liver still serves to distinguish it, through the humoral sound of the fluid; and, by changing the position of the patient, its upper edge in the majority of cases may be limited. In cases of ascites, we must lay the patient on the left side, in order to measure the right lobe, on the right side to measure the left lobe, and on the abdomen to percuss it posteriorly. Sometimes the right lobe of the liver is so enormously hypertrophied, that its inferior margin extends nearly to the right iliac fossa. (Piorry.)

When the gall-bladder is much distended with bile, or con-

tains gall-stones to any amount, it may readily be detected by percussion, and the dulness it occasions immediately under the inferior margin of the liver, anteriorly and somewhat laterally, be marked off. M. Piorry is enabled to do this in almost every case; but I must confess that I have often failed in detecting dulness caused by distended gall-bladder.

Spleen.—In percussing the spleen, it is necessary that the patient lie on the right side, and it is advantageous that the examination be made before, rather than after, meals. Anteriorly the sonoriety of the stomach and intestines causes the margin readily to be distinguished. Posteriorly, however, where the organ comes in contact with the kidneys, this is impossible. Its superior and inferior margins may be made out by striking the instrument with some force, and following the rule (No. 10) previously given. This organ offers great resistance on percussion.

The general size of the spleen is about four inches long and three inches wide. (Piorry.) In diseased states it may be atrophied or enlarged. I have seen it measure upwards of twelve inches long and eight wide. A pleuritic effusion, ascites, pneumonia, or tubercular deposition in the inferior lobe of the left lung, may render a limitation of this organ difficult or impossible. If the dulness cannot be detected, we may infer that its dimensions are small. (Mailliot.)

Stomach and Intestines.—The sounds elicited by percussion of the stomach and intestines are of the greatest service to the practitioner:—1st, As furnishing him with the means of determining the form of other organs, as the liver, spleen, or bladder; 2dly, As enabling him to distinguish the presence or absence of fæcal or alimentary matter; and, 3dly, as the means of diagnosing abdominal tumours. Hence it is incumbent on every physician to be able at once to recognise the difference between the tones furnished by the stomach, small and large intestines, under various circumstances. To arrive

at this knowledge, it is necessary to be acquainted with the relative positions of the different abdominal viscera, and the regions of the abdomen to which they correspond.

In exploring the abdomen by means of percussion, the pleximeter should first be placed immediately below the xiphoid cartilage, pressed firmly down, and carried along the median line towards the pubes, striking it all the way, now hard, now gently, with the hammer. The different tones which the stomach, colon, and small intestines furnish will thus be distinctly heard. The pleximeter should then be carried laterally, alternately to the one side, and then to the other, till the whole surface be percussed. In this manner, the different tones produced by the cœcum and ascending colon on the right side, and descending colon on the left, will be respectively distinguished from that furnished by the small intestines. The sounds and sense of resistance will be modified according as the different viscera are full or empty, as any one can determine on his own body by means of the pleximeter and hammer. When the intestines are full of fluid or solid contents, such portions may be circumscribed and marked out on the surface of the skin. I have thus often succeeded in determining the internal margin of the colon, in its ascending, transverse, or descending portions. Sometimes a portion of intestine is found lying between the abdominal walls and the stomach. The latter, however, may be readily limited, by pressing down the pleximeter, causing the patient to eat or drink, or by examining after dinner. The small intestines are almost never deprived of the tympanitic sound —a circumstance by which they may readily be distinguished from the stomach and large intestines. The distance of any particular knuckle of intestine from the abdominal walls may be pretty accurately calculated by the force necessary to be employed in pressing down the pleximeter, and striking with the hammer, in order to elicit a tympanitic or dull sound.

It is unnecessary to point out the numerous circumstances, and morbid conditions, in which percussion of the abdomen

may prove useful in practice. Displacements of the stomach or intestines, femoral and scrotal hernia, mesenteric, ovarian, and other tumours, peritoneal adhesions and effusions, may all frequently be diagnosed, and their limits determined, by a careful examination with the pleximeter and hammer. By means of percussion, even the nature of the tumour may often be arrived at; as, for instance, whether it be fungus hematodes, scirrhous, encysted, osseous, etc., by the different degrees of resistance they possess. Care, however, must be taken not to confound with tumours an enlarged spleen or liver, a distended uterus or bladder, stomach full of alimentary matter, etc.

In a practical point of view, it is often useful to determine, by means of percussion, whether an enema or a purgative by the mouth is likely to open the bowels most rapidly. If, for instance, there be dulness in the left iliac fossa, in the track of the descending colon, that part of the intestine must be full of fæces, and an enema is indicated. If, on the other hand, the left iliac fossa sound tympanitic, and the right sound dull, an enema is of little service, as it will not extend to the cœcum, and purgatives by the mouth are indicated.

Effusion of fluid into the peritoneum may be determined with great exactitude by means of percussion, and the height of the fluid marked, as in the case of pleuritic effusion. In the same manner, a change of position furnishes similar results.

Bladder.—This viscus is only to be detected by percussion, when it is more or less distended, and rises above the pubes. It may then be distinguished, and its circular margin limited, by observing the tympanitic sound of the intestines, on the one hand, and the dull humoral sound furnished by the bladder, with increased resistance, on the other. When covered by intestines, it will be necessary to press down the pleximeter with tolerable firmness, but not in such a manner as to give the patient pain. In the infant, the situation of

the bladder is not so deep in the pelvis, and a small quantity of fluid renders it cognizable by means of percussion.

A ready approximation of the state of the bladder will be found of great service in cases of fever, apoplexy delirium, imbecility, paraplegia, etc., etc. In several cases it has been found dangerously distended, on percussing the abdomen to determine the state of the intestines.

I have here only noticed those circumstances in the art of percussion which may be readily accomplished, and which every one may master in a few months by care and attention. For a description of the more delicate points, such as percussion of the kidneys and fœtus, accurately limiting the left from the right ventricle, determining and marking out the ascending and transverse portions of the arch of the aorta, etc., I must refer you to the admirable works of MM. Piorry[1] and Mailliot.[2]

[1] De la Percussion Médiate, etc , Paris, 1828. Du Procédé Opératoire, Paris, 1831. De l'Examen Plessimêtrique de l'Aorte Ascendante, et de la Crosse Aortique, etc. Archives Gén. de Méd., vol. ix., 1840, p. 431. On Percussion of the Uterus, and its Results in the Diagnosis of Pregnancy : Monthly Journal, 1846-7, p. 857.

[2] Mailliot (L.) Traité de la Percussion Médiate, etc., Paris, translated into English, with notes, by Dr George Smith of Madras.

LECTURE III.

AUSCULTATION.

The object of auscultation is to ascertain and appreciate the nature of the various sounds which occur in the interior of the body. It has been found most useful when applied to the pulmonary and circulatory organs. Auscultation of the abdomen is occasionally serviceable, especially in certain cases of pregnancy, and during labour. It has also been applied to the head, although I have never been able to make out any useful results from the practice.

GENERAL RULES TO BE FOLLOWED IN THE PRACTICE OF AUSCULTATION.

1. Auscultation may be practised directly by applying the ear to the part, or indirectly through the medium of a stethoscope. Generally speaking, direct auscultation answers every necessary purpose except when the surface is unequal, or when it is desirable to limit the sounds to a small region, as during auscultation of the heart. In either of these cases a stethoscope is necessary. The instrument is also useful to confirm or nullify the existence of certain fine sounds which may be detected by the naked ear; to remove the head of the practitioner a respectable distance from the bodies of persons not distinguished for cleanliness; and lastly, as the most delicate method of auscultating the chest anteriorly in women.

You should regard the stethoscope as a mere means to an end,—that end being, 1st, the education of the ear; and, 2d, a right appreciation of the pathological changes indicated by certain sounds.

2. In the choice of a stethoscope, you should observe, 1st, That the ear-piece fits your own ear; 2d, That the trumpet-shaped extremity is not above an inch and a-half in diameter, and is rounded so as not to injure the patient's skin when pressure is made upon it; 3d, That it is light and portable. The instruments recently made of gutta percha fulfil all these conditions.

3. In applying the ear, the surface should be covered only with a smooth piece of linen or a towel. In using the stethoscope, it should be applied to the naked skin, and held steady immediately above the trumpet-shaped extremity by the thumb and index finger, pressed down with tolerable firmness, whilst the second, third, and fourth fingers enable you to ascertain whether the circular edge be perfectly applied, which is absolutely essential.

4. The position of the patient will vary according to the part examined. In auscultating the lungs anteriorly the erect or recumbent positions may be chosen, when the two arms should be placed in a symmetrical position by the side. If the chest be examined posteriorly, the individual should lean somewhat forward and cross the arms in front. The practitioner, also, should choose such a position as will prevent too much stooping or straining. Generally speaking, the beds in the Infirmary are too low, and render auscultation very fatiguing to the physician.

5. Whenever individuals are thrown into such a state of agitation as to interfere with the regular action of the heart or lungs, the examination should be deferred until their fear diminishes, or the greatest caution should be exercised in drawing conclusions. Non-attention to this rule has led to many errors.

6. Before examining patients in a hospital, it is necessary

that you should have made yourselves perfectly acquainted with the sounds which are continually going on in the healthy body. Omission of this rule not only renders the examination of patients useless, but betrays great want of consideration. For, as it is only from the alterations the healthy sounds undergo, or their being replaced by others, that we draw conclusions, how can this be accomplished if we are ignorant of their character in the first instance? It is expected, therefore, of every examining pupil, that he should be familiar with the character and theory of the various sounds heard in the healthy body before coming to the bedside. This study belongs to the Institutes of Medicine, rather than to that of Clinical Instruction.[1]

SPECIAL RULES TO BE FOLLOWED DURING AUSCULTATION OF THE PULMONARY ORGANS.

1. In listening to the sounds produced by the action of the lungs, we should pay attention to three things: 1st, The natural respiration; 2d, The forced or exaggerated respiration; and, 3d, The vocal resonance. For this purpose, having listened to the sounds during ordinary breathing, we direct the patient to take a deep breath, and then, still listening, we ask him a question, and during his reply judge of the vocal resonance.

2. You should commence the examination immediately under the centre of one clavicle; and having ascertained the

[1] Before commencing the actual examination of patients, you should make one or more serious, careful, and prolonged examinations of the chest of one of your fellow-students in private, so as to familiarise your ear with the healthy laryngeal, tracheal, pulmonary, and cardiac sounds, and with the character of the vocal resonance, and of the cough, as heard in various parts of the chest. You should then listen in the same manner to the chest of a young boy of from five to eight years of age, and observe how clear and exaggerated the pulmonary sounds are. Then read the description of the healthy sounds, and the theory of their formation, in Barth and Roger—an excellent work, which has been translated into English by Dr Newbigging of this city.

nature of the sounds and vocal resonance there, you should immediately listen in exactly the corresponding spot on the opposite side. The examination should be continued alternately from one side to the other, in corresponding places, until the whole anterior surface of the chest is explored. The posterior surface is then to be examined in like manner.

3. When, in the course of the examination, anything different from the normal condition is discovered at a particular place, that place and the parts adjacent should be made the subject of special examination, until all the facts regarding the lesion be ascertained.

4. It is occasionally useful to tell the patient to cough, in which case we are enabled to judge,—1st, Of forced inspiration, as it precedes the cough; and, 2d, Of the resonance which the cough itself occasions.

OF THE SOUNDS ELICITED BY THE PULMONARY ORGANS IN HEALTH AND IN DISEASE.

I am anxious to impress upon you, that the sounds which may be heard in the lungs are like nothing but themselves. Students are too apt to take up erroneous notions from reading on this subject, and, instead of listening to the sound actually produced, fatigue themselves in a vain endeavour to hear something like the crackling of salt, the rubbing of hair, foaming of beer, or other noises to which these sounds have been likened. Preconceived notions frequently oppose themselves to learning the truth, and have to be got rid of before the real state of matters can be ascertained. Hence the great importance of obtaining your first impressions of the sounds to be heard by auscultation, not from books or lectures, but from the living body itself.

If you listen through your stethoscope, placed over the larynx and trachea of a healthy man, you will hear two noises,—one accompanying the act of inspiration, and the other that of expiration. These are called the *laryngeal and*

tracheal sounds or murmurs. If you next place your stethoscope a little to the right or left of the manubrium of the sternum, you will hear the same sounds diminished in intensity. These are the *bronchial sounds or murmurs.* If now you listen under and outside the nipple on the right side, or posteriorly over the inferior lobe of either lung, you will hear two very fine murmurs. That accompanying the inspiration is much more distinct than that accompanying the expiration. By some, on account of its excessive fineness, it is stated that there is no expiratory murmur in health; but this is incorrect. These sounds, then, are the *vesicular respiratory murmurs.* All these sounds become exaggerated during forced respiration, but in a state of health they never lose their soft character. Again, if you listen in the same places, whilst the individual speaks, you will hear a peculiar resonance of the voice, which has been called, in the first situation, *pectoriloquy;* in the second, *bronchophony;* while, in the third, it is scarcely audible. A knowledge of these circumstances, and a capability of appreciating these sounds, are necessary preliminary steps to the right comprehension and detection of the murmurs which may be heard during disease.

I have to suppose, then, that you have made your ears familiar with these sounds, and that you are acquainted with the present state of theory regarding their formation. This last may be stated in very few words to be, that the respiratory murmurs are occasioned by the vibration of the tubes through which the air rushes, according to well known acoustic principles. Hence they are loudest in the trachea, finer in the large bronchi, and finest in their ultimate ramifications. The vocal resonance, on the other hand, originates in the larynx; and diminishes or increases,—1st, According to the distance of any point from the source of the sound; and, 2d, According to the power which the textures have in propagating it.

If now you examine, in succession, any six of the cases in the wards which are labouring under well-marked pulmonary

diseases, you will have no difficulty in recognising that all the sounds you hear may be classified into two divisions: 1st, Alterations of the natural sounds; 2d, New or abnormal sounds, never heard during health.

I. Alterations of the Natural Sounds. — All the sounds of which we have spoken, and which can be heard in the lungs during health, may, in certain diseased conditions, be increased, diminished, or absent; their character or position may be changed; and with regard to the respiratory murmurs, they may present alterations in rhythm or duration, with respect to each other.

Alterations in Intensity.—Some persons have naturally louder respiratory murmurs than others; if this occur uniformly on both sides, it is a healthy condition. Occasionally, however, the sounds are evidently stronger in one place, or on one side (*puerile respiration*), generally indicating increased action of the lung, supplementary to diminished action in some other part. In the same manner, there may be feeble respiration simply from diminished action, as in feeble or old persons; but it may also be occasioned by pleurodynia, obstructions in the larynx, trachea, or bronchi,—pleurisy, or pulmonary emphysema, or exudations filling up a greater or less number of the air-cells and smaller tubes, as in pneumonia, phthisis, etc. Complete absence of respiration occurs when there is extensive pleuritic effusion or hydrothorax.

Alterations in Character.—The various respiratory murmurs may, in certain conditions of the lung, assume a peculiar harshness, which, to the ear of the practised auscultator, is a valuable sign, indicative of altered texture. Thus in incipient phthisis, the vesicular murmur under the clavicle is often *rude* or *harsh*. In pneumonia the bronchial respiratory murmur presents a similar character. When ulceration exists, it becomes what is called *cavernous* (hoarse or blowing); and in certain cases of pneumothorax with pulmonary fistula, it assumes an *amphoric* character.

Alterations in Position.—It frequently happens that the sounds which are natural to certain parts of the chest, are heard distinctly where in health they are never detected. Thus, in pneumonia, *bronchial* or *tubular breathing*, as it is sometimes called, may be evident, where only a vesicular murmur ought to exist. This is often well marked with regard to the vocal resonance, as certain lesions, which occasion condensation or ulceration, will enable us to hear in parts where, under ordinary circumstances, no voice can be heard, either bronchophony or pectoriloquy.

Alterations in Rhythm.—In health, the inspiration is usually three times as long as the expiration. In certain diseased conditions this relation is altered, or even inverted. In incipient phthisis we often find the expiration unnaturally prolonged. In chronic bronchitis and emphysema it is three or four times longer than the inspiration.

II. New or Abnormal Sounds.—These are of three kinds: 1st, Rubbing or friction noises; 2d, Moist rattles; 3d, Vibrating murmurs.

1. *Rubbing or Friction Noises* are caused in the pulmonary apparatus by some morbid change in the pleuræ, whereby, instead of sliding noiselessly on one another, they emit a rubbing sound. This may be so fine as to resemble the rustling of the softest silk, or so coarse as to sound like the creaking of a saddle, grating, rasping, etc.; and between these two extremes you may have every intermediate shade of friction noise. This variation in sound is dependent on the nature of the alteration which the pleuræ have undergone. If covered with a softened thin exudation, the murmur will be soft; if it be tougher and thicker, the sound will be louder; if hard, dense, and rough, it will assume a creaking, harsh, or grating character, etc., etc. These noises are heard in the various forms of pleurisy.

2. *Moist Rattles* are produced by bubbles of air traversing or breaking in a somewhat viscous fluid. This may occur in

the bronchi, when they contain liquid exudation, mucus, or pus, or in ulcers of various sizes. They may be so fine as to be scarcely audible (when they have been called *crepitating*), or so coarse as to resemble gurgling or splashing, when they have received the name of *cavernous*. Here again, between these two extremes, we may have every kind of gradation, to which auscultators have attached names, such as *mucous*, *submucous*, *subcrepitating*, etc., etc. With these names you need not trouble yourselves; all that it is important for you to determine is, that the sound be *moist*, and you will easily recognise that the rattles are coarse or large, in proportion to the size of the tubes or ulcers in which they are produced. These rattles may be heard in pneumonia, phthisis pulmonalis, bronchitis, pulmonary apoplexy, etc., etc.

3. *Dry Vibrating Murmurs* arise when the air-tubes are obstructed, constricted, or lose their elasticity and become enlarged, whereby the vibrations into which they are thrown by the column of air, produce sounds or tones of an abnormal character. Hence murmurs may be occasioned of a fine squeaking (*sibilous murmur*), or of a hoarse snoring character (*sonorous murmur*), and between the two extremes, there may be all kinds of variations, to which ingenious people have applied names. These only cause confusion; all that is necessary, being to ascertain that the murmur is *dry*, and you will readily understand that the fineness or coarseness of the sound will depend on the caliber of the tube or cavity thrown into vibrations. They are usually heard in cases of bronchitis and emphysema. Occasionally they present a blowing character, as when ulcers are dry, which often occurs in phthisis.

The *vocal resonance*, besides undergoing the changes already noticed in intensity, character, and position, may give rise to abnormal sounds. Occasionally it presents a soft reverberating or trembling noise, like the bleating of a goat (œgophony). The value of this sign, as indicative of pleurisy, was much overrated by Laennec. At present it is little esteemed.

Sometimes the resonance gives rise to a metallic noise, like dropping a shot into a large metallic basin, or the note produced by rubbing a wet finger round the edge of a tumbler or glass vessel. This is often best heard immediately after a cough in cases of pneumothorax, or large tubercular excavations of the lung. Œgophony is supposed to be produced, when a thin layer of serous fluid between the pleuræ is thrown into vibrations. The cause of metallic tinkling has created great discussion; but Drs Spittal and Skoda have shown that the existence of air in a cavity which is thrown into vibrations is the necessary condition.

Such, then, are the principal sounds which may be heard by auscultation of the pulmonary organs in health and during disease. Many writers have endeavoured to point out their diagnostic importance, and drawn up rules which have always appeared to me much too arbitrary. Indeed, in so far as the education of medical students is concerned, I have long been persuaded that the study of these rules has retarded their powers of diagnosis, and afterwards led to dangerous errors in practice. I know of no dogma, for instance, more mischievous than the one which asserts a crepitating (that is a fine moist) rattle to be pathognomonic of pneumonia, because it is just as common in phthisis, and is frequently heard in various other lesions of the pulmonary organs. Hence we should regard a crepitating rattle, not as indicative of this or that so-called disease, but simply of fluid in the smaller air passages; increased resonance of the voice, as indicating hollow spaces with vibrating walls, or increased induration of the pulmonary textures, and not as diagnostic of phthisis, pneumonia, etc.; and so on. I wish, then, strongly to impress upon you,—

1st, That the different sounds are only indicative of certain physical conditions of the lung, and in themselves bear no fixed relation to the so-called diseases of systematic writers.

2d, No single acoustic sign, or combination of signs, is invariably pathognomonic of any certain pathological state,—

and conversely, there is no pathological state which is invariably accompanied by any series of physical signs.

3d, Auscultation is only *one* of the means whereby we can arrive at a just diagnosis, and should never be depended on alone.

SPECIAL RULES TO BE FOLLOWED DURING AUSCULTATION OF THE CIRCULATORY ORGANS.

1. In listening to the sounds produced by the action of the heart and arteries, we should pay attention,—1st, To the impulse; 2d, The character and rhythm of the sounds; 3d, The place where they are heard loudest, and the direction in which they are propagated.

2. You should commence the examination by feeling for the spot where the apex of the heart beats against the walls of the chest, which will enable you to judge of the impulse. This ascertained, place your stethoscope immediately over it, and listen to the sounds. Then place the instrument above, and a little to the inside of, the nipple, near the margin of the sternum, and listen to the sounds there. In the one situation you will hear the first or systolic sound, in the other the second or diastolic sound loudest.

3. If anything different from the normal condition be discovered in either one or the other position, or in both, they should be again carefully examined, and by moving the stethoscope below and round the apex of the heart, or above, in the course of the aortic arch or carotids, on the right and left side, etc. etc., it should be ascertained at what point, or over what space, the abnormal sounds are heard loudest, and whether they be or be not propagated in the course of the large vessels. Occasionally listening over the back and in the course of the descending aorta may be useful.

4. When, during the above examination, we discover a new source of impulse and of sound in one of the large vessels, this must be especially examined, the limits of such

impulse and sound carefully ascertained,—whether they be or be not synchronous with those originating in the heart,—their direction, etc.

5. Under ordinary circumstances, the respiratory do not interfere with the detection of the cardiac sounds; but where the former are very loud and the latter indistinct, it is useful to direct the individual to hold his breath for a few moments. Sometimes the impulse and sounds of the heart are heard better by directing the patient to lean forward; they may, also, if necessary, be exaggerated and rendered more distinct by directing him to walk up and down quickly, or make some exertion for a short time.

OF THE SOUNDS ELICITED BY THE CIRCULATORY ORGANS IN HEALTH AND DISEASE.

On placing your ear over the cardiac region in a healthy person, you will feel a beating, and hear two sounds, which have been likened to the tic-tac of a watch, but to which they bear no resemblance. They may be imitated, however, very nearly, as pointed out by Dr Williams, by pronouncing in succession the syllables *lupp, dupp.* The first of these sounds, which is dull, deep, and more prolonged than the second, coincides with the shock of the apex of the heart against the thorax, and immediately precedes the radial pulse; it has its maximum intensity over the apex of the heart,—below and somewhat to the outside of the nipple. The second sound, which is sharper, shorter, and more superficial, has its maximum intensity nearly on a level with the third rib, and a little above and to the right of the nipple,—near the left edge of the sternum. These sounds, therefore, in addition to the terms first and second, have also been called inferior and superior, long and short, dull and sharp, systolic and diastolic,—all which expressions, so far as giving a name is concerned, are synonymous.

The two sounds are repeated in couples, which, if we com-

mence with the first one, follow each other with their intervening pauses, thus—1st, There is the long dull sound coinciding with the shock of the heart; 2d, There is a short pause; 3d, The short sharp sound, and 4th, A longer pause,—all which correspond with one pulsation. In figures, the duration of these sounds and pauses by some have been represented thus,—the first sound occupies a third, the short pause a sixth, the second sound a sixth, and the long pause a third. Others have divided the whole period into four parts; of which the two first are occupied by the first sound, the third by the second sound, and the fourth by the pause. The duration, as well as the loudness, of the sounds, however, are very variable even in health, and are influenced by the force and rapidity of the heart's action, individual peculiarity, and form of the thorax. Their extent also differs greatly. They are generally distinctly heard at the precordial region, and diminish in proportion as we withdraw the ear from it. They are less audible anteriorly on the right side, and still less so posteriorly on the left side. On the right side posteriorly they cannot be heard. Their tone also varies in different persons; but in health they are free from a harsh or blowing character.

Great diversity of opinion has existed regarding the causes of these sounds,—all of which you will of course have heard discussed before coming here. You must never forget, however, the cardiac actions which coincide with them; for our reasoning from any changes we may detect, will entirely depend upon our knowledge of these. We may consider, then, that there coincides with the first sound,—1st, The impulse, or striking of the apex against the thoracic walls; 2d, Contraction of the ventricles; 3d, Rushing of the blood through the aortic orifices; and 4th, Flapping together of the auriculo-ventricular valves. There coincide with the second sound,—1st, Rushing of the blood through the auriculo-ventricular valves; and 2d, Flapping together of the aortic valves. Contraction of the auricles immediately precedes

that of the ventricles. The result of numerous pathological observations, and of many experiments, is, that in health the first sound is produced by the combined action of the auriculo-ventricular valves, of the ventricles, and of the rushing of the blood, which sound is augmented in intensity by the impulsion of the heart's apex against the thorax; whereas the second sound is caused only by the flapping together of the sigmoid valves.

With the cardiac as with the respiratory sounds, the alterations which take place during the disease may be divided into—1st, Modification of the sounds heard in health; 2d, New or abnormal sounds.

I. Modifications of the Healthy Sounds.—These refer to the variations the healthy sounds present in their seat, intensity, extent, character, and rhythm.

Seat.—The sounds may be heard at their maximum intensity *lower* than at the points previously indicated, as in cases of dilated hypertrophy of the left ventricle, enlargement of the auricles, or of tumours at the base, depressing the organ. They may be *higher*, owing to any kind of abdominal swelling pushing up the diaphragm. They may be more on *one side* or the other, in cases where the heart is pushed laterally by effusions of air or fluid in a pleural cavity. Various other circumstances may also modify their natural position, such as tumours in the anterior or posterior mediastinum, aneurisms of the large vessels, adhesions of the pericardium, deformity in the bones of the chest, etc. etc.

Intensity and Extent.—These are *diminished* in cases where the heart is atrophied or softened; when there is pericardial effusion, concentric hypertrophy of the left ventricle, or emphysema at the anterior border of the left lung. They are *increased* in cases of dilated hypertrophy, of nervous palpitations, and when neighbouring portions of the lung are indurated, especially in certain cases of pneumonia and phthisis pulmonalis.

Character.—The sounds become *clearer* or *duller* than usual, according as the walls of the heart are thinner or thicker. Occasionally they sound *muffled* in cases of hypertrophy or softening of the muscular walls. Not unfrequently there is a certain degree of *roughness*, which is difficult to determine as being healthy or morbid. Occasionally it ushers in more decided changes; at others, continues for years without alteration. These alterations in character are distinguished by some auscultators as variations in the *tone* of the sounds.

Rhythm or Time.—I need not say that the frequency of the pulsations differs greatly in numerous affections altogether independent of any special disease in the heart. In certain cardiac affections, however, the beats are *intermittent*, in others *irregular*—that is, they succeed each other at unexpected intervals. The *number* of the sounds also varies. Sometimes only one can be distinguished, it being so prolonged as to mask the other. Occasionally three or even four sounds may be heard, depending either on reduplication in the action of the valves when diseased, or on want of synchronism between the two sides of the heart. Not unfrequently the increased and irregular movements of the organ, combined with the sounds, are of such a character as to receive the name of *tumultuous*.

II. New or Abnormal Sounds.—These are of two kinds: 1st, Friction murmurs; 2d, Blowing or vibrating murmurs. Dr Latham has called them *exocardial* and *endocardial*. I am in the habit of denominating them *pericardial* and *valvular*.

Pericardial or Friction Murmurs.—These murmurs are the same in character, and originate from the same causes, as the friction noises connected with the pulmonary organs. It is only necessary to observe, that occasionally they are so soft as closely to resemble blowing murmurs, from which they are only to be distinguished by their superficial character and limited extent.

Valvular or Vibrating Murmurs.—These murmurs vary greatly in character; some being so soft as to resemble the

passage of the gentlest wind; others are like the blowing or puff from the nozzle of a bellows (*bellows murmurs*); whilst others are harsher, resembling the noise produced by *grating, filing, sawing,* etc. They are all occasioned, however, by diseases interfering with the functions of the valves. Sometimes these do not close, and the blood consequently regurgitates through them; at others, whilst this is the case, they are constricted, indurated, roughened, and even calcareous,—whence the harsher sounds. They may be single or double, and have their origin either in the auriculo-ventricular or arterial valves, or in both at once, the detection of which constitutes the diagnosis of the special diseases of the organ. Occasionally these sounds resemble *musical notes,* more or less resembling the cooing of a dove, singing or twittering of certain small birds, whistling, tinkling, etc. etc. These depend either upon excessive narrowing of the orifices, or upon any causes which induce vibrations of solids in the current of blood,—as, when there are perforations in the valves, irregularities of their margins, string-like or other shaped exudations on their surface, etc. etc.

AUSCULTATION OF THE LARGE VESSELS.

On listening through the stethoscope placed over the arteries in the neighbourhood of the heart, we hear the same sounds as are produced at the sigmoid valves, propagated along its course, but more indistinct as we remove the instrument from the base of the heart. Those which are more distant have only one sound, which is synchronous with their impulse and their dilatation. This sound is of a dull character, but in health always soft.

In the various conditions of disease we have a single or double bellows sound, or it may be harsh, grating, rasping, etc. In the first place, you must ascertain whether any of these sounds are propagated along the artery from the heart,

which you will know by listening over its course from that organ, and observing whether they increase as you proceed towards it. If the sound have an independent origin, it may originate from disease of the internal surface of the artery, when it will be harsh in proportion to the roughness; from stricture of, or pressure on the vessel, or from its dilatation. Generally speaking, the more dilated and superficially seated the vessel is, the sharper is the sound. Sometimes there is a double murmur in the course of a vessel, having an undoubted independent origin. This is most common in cases where there is an aneurismal pouch, into which the blood passes in and out through an opening narrower than the swelling itself. Occasionally one or both such murmurs may possess somewhat of a metallic ringing, or even musical character, when the margins of the opening are probably tense, and thrown into peculiar vibrations.

I have already told you never to form a conclusion from auscultation alone. Even when combined with percussion, it is not safe to form a diagnosis without a knowledge of *all* the circumstances of the case. Hence why I repudiate those rules which have been published in books, that have for their object the establishment of opinions from physical signs alone. At the same time, there can be no doubt that percussion and auscultation are absolutely essential to the proper investigation of maladies, although not more so than other modes of inquiry. I have, therefore, thought it best to give you a condensed resumé of the sounds which may be heard by auscultation of the lungs, heart, and large vessels; pointing out a few of the diseased states in which they may be sometimes (not always) heard, and especially indicating the physical conditions on which they are supposed to depend. Their true diagnostic value can only be learned by the careful examination of individual cases.

I may conclude this subject by giving a few general rules diagnostic of pulmonary and cardiac diseases.

GENERAL RULES DIAGNOSTIC OF PULMONARY DISEASES.

1. A friction murmur heard over the pulmonary organs indicates pleuritic exudation.

2. Moist, or dry râles, without dulness on percussion, or increased vocal resonance, indicate bronchitis, with or without fluid in the bronchi.

3. Dry râles accompanying prolonged expiration, with unusual resonance on percussion, indicate emphysema.

4. A moist râle at the base of the lung, with dulness on percussion and increased vocal resonance, indicates pneumonia.

5. Harshness of the inspiratory murmur, prolonged expiration, and increased vocal resonance confined to the apex of the lung, indicate incipient phthisis.

6. Moist râles, with dulness on percussion, and increased vocal resonance at the apex of the lung, indicate either advanced phthisis or pneumonia. The latter lesion commencing at or confined to the apex is rare, and hence these signs are diagnostic of phthisis.

7. Circumscribed bronchophony or pectoriloquy, with cavernous dry or moist râle, indicates a cavity. This may be dependent on tubercular ulceration, a gangrenous abscess, or a bronchial dilatation. The first is generally at the apex, and the last about the centre of the lung.

8. Total absence of respiration indicates a collection of fluid or of air in the pleural cavity. In the former case there is diffused dulness, and in the latter diffused resonance on percussion.

9. Marked permanent dulness, with increased vocal resonance and diminution or absence of respiration, may depend on chronic pleurisy, on thoracic aneurism, or on a cancerous tumour of the lung. The diagnosis between these lesions must be determined by a careful consideration of the concomitant signs and symptoms.

The general diagnostic indications now noticed as being derivable from physical signs, admit of several exceptions, which, however, it would be difficult to systematise. Hence they can only be acquired from a careful study of individual cases. It is important also to remember that these signs should never be relied on alone, but be invariably combined with a minute observation of all the concomitant symptoms. Thus the signs indicative of incipient phthisis may be induced by a chronic pleurisy confined to the apex, or to retrograde tubercle. In either case, the previous history, age, etc., may enable you to determine the nature of the lesion. Again, it may be impossible at the moment of examination to distinguish between two diseases. For instance, there may be general fever, more or less embarrassment of the respiration, and pain in the side, accompanied with no dulness on percussion, but with a decided abnormal murmur, difficult to characterise, as being a fine moist rattle, or a gentle friction sound. Under such circumstances, the progress of the case will soon relieve you from any doubt as to whether a pleurisy or a pneumonia be present. The alterations which occur in the physical signs during the progress of the case also will indicate to the pathologist the changes which occur in the physical conditions and morbid lesions of the lungs. Thus the fugitive dry or mucous râles heard during a bronchitis, point out the occasional constrictions and obstructions in the bronchial tubes. The fine crepitation of incipient pneumonia, passing into absence of respiration, and this again into crepitation, will satisfy him as to effusion, solid coagulation and subsequent softening of the exudation. In the same way, by an accurate appreciation of physical signs and a thorough knowledge of morbid anatomy, the practised physician can tell the abnormal conditions produced by phthisis, pleurisy, etc., and judge from the symptoms the effects of these upon the constitution, with a degree of accuracy that to the tyro must appear to be marvellous. All such knowledge can only be acquired by constant examination of the patient on the one hand, and by

a careful study of morbid anatomy in the pathological theatre, on the other.

GENERAL RULES DIAGNOSTIC OF CARDIAC DISEASES.

1. In health, the cardiac dulness on percussion measures two inches across, and the extent of dulness beyond this measurement indicates either the increased size of the organ, or the extent of pericardial effusion.

2. In health, the apex of the heart may be felt and seen to strike the chest between the fifth and sixth ribs, immediately below and a little to the outside of the left nipple. Any variations that may exist indicate the altered positions of the apex in disease.

3. A friction murmur indicates pericardial exudation.

4. A bellows murmur with the first sound, heard loudest over the apex, indicates mitral insufficiency.

5. A bellows murmur with the second sound, heard loudest at the base, indicates aortic insufficiency.

6. A murmur with the second sound, loudest at the apex, is very rare, but when present it indicates mitral obstruction, is almost always associated with insufficiency, and the murmur is double.

7. A murmur with the first sound, loudest at the base, and propagated in the direction of the large arteries, is more common. It may depend,—1st, on an altered condition of the blood, as in anæmia; 2d, on dilatation or disease of the aorta itself; and 3dly, on stricture of the aortic orifice,—in which case it is almost always associated with insufficiency, and the murmur is double.

8. Hypertrophy of the heart may be independent of valvular disease, but this is very rare. In the vast majority of cases it is the left ventricle which is affected, in connection with mitral or aortic disease. In the former case the hypertrophy is equal with rounding of the apex; in the latter there is dilated hypertrophy, with elongation of the apex.

Attention to these rules alone will, in the great majority of cases, enable you to arrive with precision at the nature of the lesion present. In cases in which there may be any doubt, you will derive further assistance from an observation of the concomitant symptoms, such as,—1st, the natnre of the pulse at the wrist; 2d, the nature of the pulmonary or cerebral derangements. Thus, as a general rule, but one on which you must not place too much confidence, the pulse is soft or irregular in mitral disease, but hard, jerking, or regular in aortic disease. Again, it has been observed that cerebral symptoms are more common and urgent in aortic disease, and pulmonary symptoms more common and urgent in mitral disease.

I purposely say nothing of diseases of the right side of the heart, and of a few other rare disordered conditions of the organ,—1st, because they occur so seldom as scarcely to merit our attention; and, 2d, because I am convinced that an appreciation of the rules above given is the best method of enabling you to comprehend and easily detect any exceptional cases which may arise. In truth, however, we have seen in our examinations at the bed-side that your difficulty is, not how to arrive at correct conclusions from such and such data, but how to arrive at the data themselves. You have to determine,—1st, by percussion, whether the heart be of its normal size or not; 2d, whether an abnormal murmur does or does not exist; 3d, if it be present, does it accompany the first or second sound of the heart; and 4thly, at what place and in what direction the murmur is heard loudest. These points ascertained, the conclusion flows from the rules previously given. But no instruction on my part, no reading or reflection on yours, will enable you to ascertain these facts for yourself. In short, nothing but percussing the cardiac region with your own hands, and carefully listening to the sounds with your own ears, can be of the slightest service, and the sooner you feel convinced of this truth the sooner are you likely to overcome these preliminary difficulties.

LECTURE IV.

THE MICROSCOPE AS A MEANS OF DIAGNOSIS.

There are still a few teachers who consider the microscope as useless in the investigation of disease. I believe, on the contrary, that our acquaintance with the ultimate structure of the human body, in its healthy and diseased conditions, is now so advanced, and good microscopes are so common and cheap, as to warrant their introduction among the instruments of the medical practitioner. You must not suppose that an additional method of gaining information implies abandonment of those, the utility of which has stood the test of experience. Men must learn the every-day use of their senses; must know how to feel, hear, and see, in the same manner as they did before instruments were invented. We don't see the stars less clearly with our naked sight, because the telescope is necessary for an astronomer. Neither should a physician observe the symptoms of a disease less accurately because he examines the chest with a stethoscope, or a surgeon be less dexterous with the knife, because it is only by means of the microscope he can determine with exactitude the nature of a tumour. But it is unnecessary to enter into a lengthened argument to prove that the science and art of medicine are greatly indebted, in modern times, to the invention and proper application of ingenious instruments. The following examples will serve to convince you that the microscope is one of these:—

Example 1.—Some years ago I was summoned to see a

Dispensary patient labouring under bronchitis, who was spitting florid blood. On examining the sputum with a microscope, I found that the coloured blood corpuscles were those of a bird. On my telling her she had mixed a bird's blood with the expectoration, her astonishment was unbounded, and she confessed that she had done so for the purpose of imposition.

Example 2.—A gentleman, for some years, had laboured under a variety of anomalous symptoms, referable to the head and digestive systems, under which he had become greatly reduced. He had consulted many practitioners, and visited innumerable watering places, in a vain search after health. On examining the urine with a microscope, I found it crowded with spermatozoa. He evidently laboured under spermatorrhœa, a disease which had never been suspected, but which was readily cured on the employment of an appropriate treatment.

Example 3.—A boy was brought to me with an eruption on the scalp, which was of so indefinite a character that its nature could not be determined. He had lately been elected to occupy a vacancy in one of our charitable educational establishments, and the question to decide was, whether the disease was or was not contagious. On examining the scab with a microscope, I readily discovered the *Achorion Schoenleini*, or fungus constituting true favus; and as this has been experimentally proved to be inoculable, I had no hesitation in preventing his admission to the school.

Example 4.—A child was supposed to be affected with worms, because it passed in abundance yellowish shreds, which, to the naked eye, closely resembled ascarides. All kinds of vermifuge remedies had been tried in vain. On examining the shreds with a microscope, I found them to consist of the undigested spiral vessels of plants; and they

ceased to appear when the vegetable broth used as food was abandoned.

Example 5.—I was called to see an infant, a month old, which was in a state of considerable emaciation, with constant diarrhœa. The mother, however, maintained that her milk was abundant, and that it was taken in sufficient quantity. On being examined with a microscope, it was found to contain numerous compound granular bodies, and comparatively few milk globules. In short, it presented, in an exaggerated degree, all the characters of colostrum, and this thirty days after delivery. It was evident then that the *quality* of the milk was in fault, an opinion which was confirmed by the recovery of the infant, when a healthy nurse was procured.

Example 6.—An individual was supposed to be labouring under dysentery, from the frequent passage of yellowish pulpy masses in the stools, accompanied with tormina and other symptoms. On examining these masses with the microscope, I found them to consist of undigested potato skins. On inquiry, it was ascertained that this person eat the skins with the potatoes. On causing these to be removed before dinner, the alarming appearance ceased, and the other symptoms also disappeared.

Example 7.—An eminent surgeon, in London, was treating a case, of what he considered to be pharyngeal abscess. Before opening it, however, he scraped off a little of the matter on its surface with his nail, and took it to Mr Quekett, who told me that, on examining it with a microscope, he found it to contain numerous cancer cells. The tumour was allowed to progress uninterruptedly; and on the death of the individual, some months afterwards, the bones at the base of the cranium were found to be enlarged, from a cancerous growth.

Example 8.—A child had been suffering for four years

from copious and fœtid discharge from the nostrils, accompanied with great pain. At the end of that time, a dark brown and indurated mass was discharged about an inch long, and a quarter of an inch broad, closely resembling a sequestrum of bone. This mass I was requested to examine microscopically by Dr Littlejohn, whose case it was, and from its structure I readily determined that it consisted of some fir wood. When this was known the parents remembered that, about the time the disease commenced, alterations were made in the house, and that the children used to play with the wood shavings. There could be little doubt that a piece of shaving had been thrust up the nose, and been the cause of all the symptoms.

Examples of this kind could be readily multiplied. No doubt, mistakes will be made with this instrument in the hands of inexperienced persons, in the same manner as the use of the stethoscope, or of a knife, may lead to a false conclusion, or to an accident. But this, so far from being an argument opposed to their employment, only proves the necessity of becoming more skilful in their use. Certainly there is none which requires more expert management in itself, or more caution in drawing conclusions from its employment, than the microscope.

DESCRIPTION OF THE MICROSCOPE.

It is not my intention to enter upon a description of the optical principles on which microscopes are constructed, although you will find a knowledge of these very useful. I shall suppose that you are desirous of obtaining an instrument that will answer all the purposes of the anatomist and physiologist, as well as afford you every possible assistance in the way of diagnosis as medical men. For this purpose, you should learn to distinguish what is necessary from what is unnecessary, in order that you may procure

the former in as convenient a form, and at as moderate a cost, as possible.

A microscope may be divided into mechanical and optical parts. The former determine its general form and appearance. Of the numerous models which have been invented, the one here figured, exactly one-fourth its real size, appears to me the most useful for all the purposes of the physiologist and medical practitioner. The body consists of a telescope tube, eight inches in length, held by a split tube, three inches

Fig. 3.

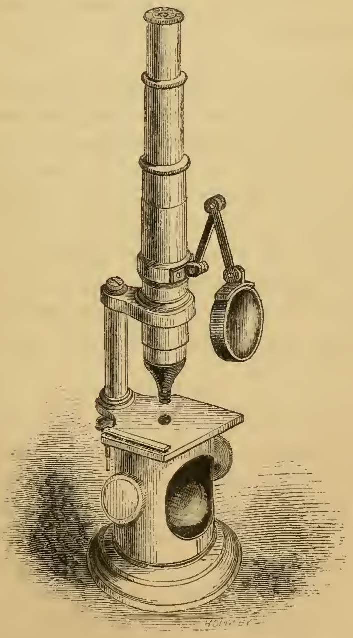


Fig. 3.--Oberhaeuser's latest model, made at my suggestion for medical men.

long. It may be elevated and depressed with great readiness by a cork-screw movement, communicated to it by the hand, and this constitutes the coarse adjustment. It is attached to a cross bar and pillar, at the lower portion of which last, very conveniently placed for the hand of the observer, is the fine adjustment. The stage is three inches broad, and two and a-half inches deep, strong and solid, with a circular diaphragm below it. The base of the instrument is heavily loaded with lead to give it the necessary steadiness.

This form of microscope possesses all the mechanical qualities required in such an instrument. These are,—1st, Steadiness; 2d, Power of easy adjustment; 3d, Facility for observation and demonstration; and 4th, Portability.

1. *Steadiness.*—It must be evident that if the stage of the microscope possesses any sensible vibration, minute objects, when magnified highly, so far from being stationary, may be thrown altogether out of the field of view. Nothing contributes more to the comfort of an observer than this quality of a microscope, and great pains have been taken to produce it. In the large London instruments this end has been admirably attained, but at so much cost and increase of bulk as to render it almost useless. In the small model I have recommended, all the steadiness required is present in the most convenient form.

2. *Power of Easy Adjustment.*—It is a matter of great importance to those who use the instrument much, and work with it for hours together, that the adjustment should work easily and rapidly, and be placed in convenient situations. Nothing can be more commodious than the manner in which these ends are arrived at in the model figured. By insertion of the body of the instrument within a split tube, you may, by a spiral movement, elevate and depress it with the greatest rapidity, and even remove it altogether if necessary. The necessity of continually turning the large screws affixed to

most microscopes, becomes fatiguing in the extreme. Then the fine adjustment, placed conveniently behind the microscope, near the hand which rests on the table, is in the very best position; whereas, in some London instruments, it is placed on the top of the pillar, so that you must raise your hand and arm every time it is touched. In other London instruments, it is placed in front of the body, so that you must stretch out the arm and twist the wrist to get at it. No one could work long with so inconvenient a contrivance.

3. *Facility for Observation and Demonstration.*—For facility of observation and demonstration, it is necessary that the instrument should be of a convenient height, and that the stage on which the objects are placed should be easily accessible. Here, again, nothing can be more commodious than the microscope I have recommended, for, when it is placed on a table, its height is almost on a level with the eye, and we can look through it for hours without the slightest fatigue. On the other hand, the stage is elevated, just so much as enables the two hands, resting on their external edges, to manipulate with facility all kinds of objects placed upon it. The large London instruments are so high, as to render it necessary to stand up to see through them. To obviate this disadvantage, a movement is given to the body, by which it can be depressed to any angle. But this movement renders the stage oblique, and removes it to a distance, where it becomes very inconvenient to manipulate on its surface. To obviate this difficulty, the stage itself has been rendered moveable in various ways by different screws, so that in this way complexity has been added to complexity, until a mass of brass work and screws is accumulated, to the advantage of the optician, but to the perplexity and fatigue of the observer. But by no contrivance is it possible to avoid the aching arms which such a position of the stage invariably produces in those who work with such a cumbrous machine for any length of time.

4. *Portability.*—This is a property which should by no means be overlooked in instruments that are intended more for utility than ornament. A medical man is often called upon to verify facts in various places; at his own house, at an hospital, at the bed-side of his patient, or at a private post-mortem examination. It is under such circumstances that the value of portability is recognised. The large London instruments require an equipage or a porter to transport them from place to place; even the putting them in and out of the large boxes or cabinets that are built around them, is a matter of labour. In short, notwithstanding the splendour of the screws, the glittering of the brass, and the fine workmanship, there can be little doubt that, on the whole, they are very clumsy affairs.

There are many occasions on which a medical man may find it useful to carry a microscope with him, especially in the case of post-mortem examinations. Many attempts have been made to construct a pocket-microscope; and for the

Fig. 4.

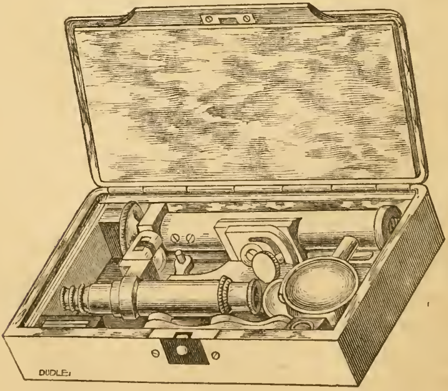


Fig. 4.—Gruby's compound pocket microscope, exactly one-half the real size.

purposes above alluded to, I myself planned one some years ago, which with its case, resembled a small pocket telescope. Dr Gruby of Paris, however, has planned the most ingenious instrument of this kind, which possesses most of the pro-

Fig. 5.

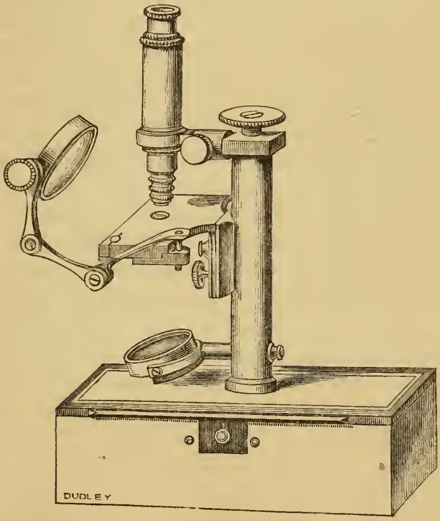


Fig. 5.—The same microscope mounted, ready for use.

perties we have enumerated, and will be found very useful for those accustomed to microscopic manipulation. It is contained in a case, the size of an ordinary snuff-box, and possesses all the conveniences of the larger instruments, with various lenses, a micrometer, slips of glass, needle, knife, and forceps, in that small compass. The prefixed wood-cuts, exactly one-half the real size, will give an idea of this ingenious microscope, manufactured by Brunner of Paris. For a more

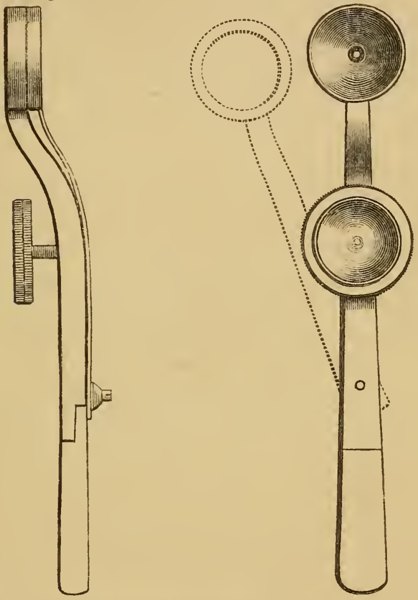
minute description, I must refer you to the " Monthly Journal of Medical Science" for December 1846.

There is a general feeling among the public that the larger a microscope is, the more it must magnify; but I need not tell you this is error. A very imposing mass of brasswork and mechanical complexity, is no guarantee that you will see objects better, or, what is of more consequence, become good observers. On the contrary, the more unwieldy the instrument, the less disposed will you be to use it. Besides, the habitual employment of artificial methods of moving about the object, as by the screws of a moveable stage, will prevent your acquiring that dexterous use of your fingers and accuracy of manipulation which are at all times so useful. Nothing, indeed, can be more amusing than to see a man twisting his screws, pushing his heavy awkward stage about, and laboriously wasting time to find a minute object which another can do in a moment, and without fatigue, by the simple use of his fingers. But perhaps you will consider the weightiest objection to the large instruments is the expense they necessitate,—the cost being necessarily in proportion to the amount of brass and mechanical labour employed upon them. If, then, you have to choose between a complex model and a simple one, I strongly advise you, as a matter of real economy, to choose the latter. Indeed the former, to a practical histologist, is worthless.

A very simple form of miscroscope was presented to the Physiological Society of Edinburgh, at its meeting on the 7th of June 1851, by Dr W. T. Gairdner (Figs. 6 and 7). It consists of a Coddington lens, so small that the focal distance is about the $\frac{1}{15}$th of an inch, and the magnifying power from 150 to 250 diameters linear. This lens is fixed in a round plano-concave disc of brass, attached to a small handle of brass. On the plane side is a ring of silver, in which a thin piece of glass is fitted, also supported by a handle of brass. The two handles are united together by means of a fine screw, so that exact focal distance is attained. A drop of

fluid placed on the *outside* of this glass, either covered or not with another glass, then applied to the eye, and directed to-

Fig. 6. Fig. 7.



GAIRDNER'S SIMPLE CLINICAL MICROSCOPE.—Fig. 6, a lateral view of the instrument. Fig. 7, a front view, showing in outline the posterior glass separated and turned aside.

wards the light, will enable us to distinguish blood, pus, epithelial, or other corpuscles, various forms of crystals, etc., sufficient, *to experienced eyes*, for the purposes of diagnosis. By shading the lens externally with the finger, all the effects of a diaphragm can be produced. It must not be supposed that this instrument will ever supersede the necessity of studying histology by means of a larger one; but, to him who is already familiar with minute objects, it will prove a

valuable acquisition at the bedside. It is made by Bryson, optician, Princes Street.

We have next to speak of the optical parts of microscopes, which are certainly much more important than the mechanical ones,—everything depending upon obtaining a clear and distinct image of the object examined. Under this head we may describe the objective, the eye-piece, and methods of illumination.

1. *The Objective, or series of Achromatic Lenses*, is that part of the optical portion of a microscope which is placed at the bottom of the tube or body, and is near the object to be examined. This may be considered the most important part of the instrument, and the greatest pains have been taken by all opticians in the manufacture of good lenses. It is here I consider that the London opticians are pre-eminent, for I am not aware that in any part of the world such perfect objectives have been manufactured as the eighth of an inch by Smith, the twelfth of an inch by Ross, and the sixteenth of an inch by Powell. But when we come down to the one-fourth of an inch, which is by far the most useful objective for anatomical and medical purposes, the superiority of the London opticians is very slight, if any. At this magnifying power the compound lenses of C. Chevalier, Oberhaeuser, Brunner, and Nachet of Paris, Schiek and Pistor of Berlin, Frauenhofer of Munich, and Ploesl of Vienna, may be employed with the greatest confidence, and it may be said that by far the largest number of important discoveries in science have been made through their employment. The Parisian lenses, in addition, have one great advantage, namely, their cheapness.

The London opticians have succeeded in combining the lenses of their objectives, so as to obtain a large field of vision, with as little loss of light as possible. These qualities are valuable in the lower magnifying lenses during the ex-

amination of opaque objects, and in the higher ones when observing transparent objects by transmitted light. But in the lenses of medium power, such as the one-fourth of an inch, the amount of light is so great as to be almost a defect. Notwithstanding careful management of the mirror and diaphragm, the field of vision is often dazzling, and always presents a glare most detrimental to the eyes of the observer. I cannot employ Ross's fourth of an inch for fifteen minutes without feeling intense headache, and I know of more than one excellent observer in whom the sight has so much suffered from this cause as to incapacitate them from continuing their researches. In the same manner, the lenses of Brunner and Nachet give rise to a yellow light highly disagreeable; while those of Oberhaeuser, Schiek and Pistor, and Frauenhofer (with Amici's and Ploesl's I am not familiar), present a pale blue light, most pleasant to work with, and which may be gazed at for hours without fatiguing the eye.

For the above reasons, as well as from considerable experience in the use of many kinds of microscopes by different manufacturers, I am satisfied that the best lens you can employ for ordinary purposes is Oberhaeuser's No. 7, which corresponds to what is called in England the quarter of an inch. For low powers you may have Oberhaeuser's No. 3, or the one inch lens of the London opticians. For all the wants of the medical man these will be sufficient. The anatomist may occasionally require a higher lens, as during the examination of the ultimate fibrillæ of muscle, when the eighth, twelfth, or sixteenth of an inch of the London optitians may be procured. All these lenses may be attached to the model we have recommended by means of a brass screw made on purpose.

2. *The Eye-Piece.*—This is that portion of the optical apparatus which is placed at the upper end of the tube or body, and is near the eye of the observer. While the objec-

tive magnifies the object itself, the eye-piece only magnifies the image transmitted from below. Hence, as a source of magnifying power, it is inferior to the lens; and when this possesses any defects, these are enlarged by the eye-piece. Two eye-pieces are all that is necessary with the model I have recommended, and those of Oberhaeuser, called Nos. 3 and 4, are the most useful for the medical man.

3. *Methods of Illumination.* — There are few things of more importance to the practical histologist than the mode of illumination. This is accomplished,—1st, By transmitted light; 2d, By reflected light; and 3d, By achromatic light.

Transmitted light is obtained by means of a mirror placed below the object, which, to be seen, must therefore be transparent. In large microscopes the mirrors are provided with universal joints, so that they may easily be turned in any direction. Below the stage every microscope should possess a diaphragm pierced with variously sized holes, whereby the amount of light furnished by the mirror may be moderated. In Oberhaeuser and Nachet's instruments the smallest aperture should be employed for the higher objective. It is also useful in the examination of many objects that the light should be directed upon them sideways; this may be done by the diaphragm, or by the mirror, and, in the small model formerly figured, is admirably attained by simply turning the whole microscope. The best light for microscopic purposes is that obtained by catching the rays which are reflected from a white cloud. The conjoined use of the mirror and diaphragm can only be learned from actual experience.

Reflected light is employed in the examination of opaque objects, and the lenses of low power, manufactured by the principal London opticians, enable us to do so without assistance. Occasionally, however, the light of the sun is useful; and when this cannot be obtained, the rays of a lamp or gas light, concentrated by a bull's-eye lens, may be employed. Hence every microscope should be possessed of such

a lens, and it is most convenient to have it attached to the body of the instrument by a moveable ring, and stem with two joints, as in the model figured.

Achromatic light is only serviceable in the examination of very delicate objects, with high powers. The apparatus necessary for obtaining it is occasionally useful in ascertaining the ultimate structure of muscle, or the nature of the markings on minute scales or fossils, but is useless for the purposes of the medical man. In the same way I know of no benefit to be obtained by a polarising apparatus.

In addition to the mechanical and optical parts constituting the microscope itself, the box which contains it should possess a convenient place for holding a few slips of glass, a pair of small forceps, a knife, and two needles firmly set in handles. A micrometer to measure objects with is also necessary to those who are making observations with a view to their exact description. No other accessories are necessary.

An excellent microscope of the model previously figured, by Oberhaeuser, with two objectives (Nos. 3 and 7), two eye-pieces (Nos. 3 and 4), a neat box with all the accessories necessary (with the exception of a micrometer, which had better be English) may be obtained in Paris for the sum of about 150 francs (L.6), and will cost in Edinburgh, after payment of carriage and duty, about seven guineas. Nachet and Brunner's instruments are much cheaper, as are the smaller models of Oberhaeuser. Either of them, for all the purposes of the medical man, is amply sufficient.

Test-Objects.—The defining power of a microscope is generally tested by examining with it a transparent object, having certain fine markings, which can only be rendered clearly visible when the glasses are good. In all such cases, it is of course necessary to be familiar with the structure of the test-object in the first instance. If you are not confident

on this point, it is better to trust to the judgment of a friend, whose knowledge of histology is ascertained, or place your dependence entirely on a respectable optician. One of the best test-objects for a quarter of an inch lens is a drop of saliva from the mouth. For, if the microscope shows with clearness the epithelial scales, the structure of the salivary globules, their nuclei, and contained molecules, you may be satisfied that the instrument will exhibit all the facts with which, as medical men, you have to do.—(See Fig. 9.)

MENSURATION AND DEMONSTRATION.

Having, then, obtained a good instrument, and tested its qualities in the manner described, you should next determine the number of diameters linear the various combinations of glasses magnify. This you may do for yourself with the aid of a micrometer, a pair of compasses, and a measure.

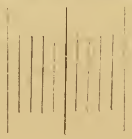
A micrometer is a piece of glass on which lines are ruled at the distance of $\frac{1}{100}$th or $\frac{1}{1000}$th of an inch. This must be placed under the instrument, when the lines and the distances between them will of course be magnified by the combination of glasses employed, like any other object. Taking a pair of compasses in one hand, we separate the points, and place them on the stage (always on a level with the micrometer magnified). Now, looking through the instrument with one eye, we regard the points of the compasses with the other, and mark off by the naked sight, say the $\frac{1}{100}$th of an inch, as magnified by the instrument. Though difficult at first, a little practice enables us to do this with the greatest accuracy. The result is, that if the distance magnified and so marked off ($\frac{1}{100}$th of an inch) is equal to three inches, the instrument magnifies 300 times linear; if two inches, 200 times; and so on.

To measure the size of objects, they may be placed directly on the micrometer; but as this is at all times inconvenient, whilst the object and micrometer, from their not being in the

same plane, cannot, under high powers, both be brought into focus at once, it is better to use an eye-micrometer. Many ingenious inventions of this kind are to be procured. The most simple is a ruled micrometer placed in the focus of the upper glass of the eye-piece. With this we observe how many divisions of the eye-micrometer correspond with one of those magnified by the microscope, always making our observation in the centre of the field, where the aberration of sphericity is least. On the latter being removed and replaced by an object, it becomes a matter of mere calculation to determine its size. Thus, supposing each of the upper spaces in Fig. 8 to represent the $\frac{1}{1000}$th of an inch magnified 250

Fig. 8.

Spaces equal to 1-1000th of an inch magnified 250 diameters linear.



Five ruled spaces in an eye-micrometer, corresponding to one of those above, and each consequently equal to the 1-5000th of an inch.

diameters linear, and five of the lower spaces, as seen in an eye-micrometer, to correspond with one of these, it follows that each of these latter must measure the thickness of an object so magnified equal to $\frac{1}{5000}$th of an inch. Oberhaeuser has made beautifully ruled eye-micrometers, for the model recommended, which those who wish to make measurements would do well to procure.

If it be not in your power to estimate the magnifying power for yourself, the optician will give you a table, setting forth the various degrees of enlargement possessed by the lenses, and different eye-pieces, with the tube up or down. This table should always be referred to during the description of objects, and the amount of magnifying power invariably stated.

The art of demonstrating under the microscope is only to be acquired by long practice, and, like everything requiring practical skill, cannot be learnt from books or systematic lectures. I can only, therefore, give you very general directions on this head.

All that is necessary in examining fluid substances, is to place a drop in the centre of a slip of glass, and letting a smaller and thinner piece of glass fall gently upon it, so as to exclude air bubbles, place it upon the stage under the objective. In this way the fluid substance will be diffused equally over a flat surface, and evaporation prevented, which would dim the objective. The illumination must now be carefully arranged, and the focus obtained, first by means of the coarse, and then by means of the fine, adjustment. It will save much time, in examining structures, to employ always, at one sitting, the same slips of glass, as it is easier to clean these with a towel, after dipping them in water, than to be perpetually shifting the coarse adjustment.

The action of water, acetic acid, and other re-agents, on the particles contained in the fluid, may be observed by adding them to another drop before covering with the upper glass; or when this is done, a drop of the re-agent may be placed at the edge of the upper glass, when it will be diffused through the fluid under examination by imbibition.

The mode of demonstrating solid substances will vary according as they are soft or hard, cellular or fibrous, etc. etc. The structure of a soft tissue, such as the kidney, skin, cartillage, etc., is determined by making very minute, thin, and

transparent slices of it in various directions, by means of a sharp knife or razor. These sections should be laid upon a slip of glass, then covered over, and slightly pressed flat, by means of an upper one. The addition of a drop of water renders the parts more clear, and facilitates the examination, although it should never be forgotten that most cell-structures are thereby enlarged or altered in shape from endosmosis. Acid and other re-agents may be applied in like manner. The double-bladed knife of Valentin will enable you to obtain large, thin, and equable sections of such tissues, and permit you to see the manner in which the various elements they contain are arranged with regard to each other. Harder tissues, such as wood, horn, indurated cuticle, etc., may be examined by small thin sections, made in the same way. Very dense tissues, such as bone, teeth, shell, etc., require to be cut into thin sections, and afterwards ground down to the necessary thinness. Preparations of this kind are now manufactured on a large scale, and may be obtained at a trifling cost. A cellular parenchymatous structure, such as the liver, may be examined by crushing a minute portion between two glasses. If it be membranous, as the cuticle of plants, epithelial layers, etc., the membrane should be carefully laid flat upon the lower glass, and covered with an upper one. A fibrous structure, such as the areolar, elastic, muscular, and nervous tissues, must be separated by means of needles, and then spread out into a thin layer before examination, with or without water, etc.

The commencing observer should not be discouraged by the difficulties he will have to encounter in dissecting and displaying many tissues. He must remember that the figures he sees published in books are generally either fortunate or very carefully prepared specimens. Practice will soon enable him to obtain the necessary dexterity, and to convince himself of the importance of this mode of inquiry. He should early learn to draw the various objects he sees, before and after the action of re-agents, not only because such copies

constitute the best notes he can keep, but because drawing necessitates a more careful and accurate examination of the objects themselves. A note-book and pencil for the purpose should be the invariable accompaniments of every microscope.

HOW TO OBSERVE WITH A MICROSCOPE.

The art of observation is at all times difficult, but is especially so with a microscope, which presents us with forms and structures concerning which we had no previous idea. Rigid and exact observation, therefore, should be methodically cultivated from the first, in order to avoid those errors into which the tyro, when using a microscope, is particularly liable to fall. Thus you should carefully examine the physical properties of the particles and ultimate structures you may see, and not hastily conclude that you have under observation so-called pus, tubercle, or cancer-corpuscles, because they were obtained from what was, *a priori*, believed to be pus, tubercle, or cancer. Nothing has been more clearly demonstrated by the progress of histology, than the fact, that the naked sight has confounded different structures together, from a similarity of external appearance, and that the greatest caution is required at all times, but especially by learners, in forming opinions as to the nature of different tissues.

The physical characters which distinguish microscopic objects consist of,—1st, Shape; 2d, Colour; 3d, Edge or border; 4th, Size; 5th, Transparency; 6th, Surface; 7th, Contents; and 8th, Effects of re-agents. These we may notice in succession.

1. *Shape.*—Accurate observation of the shape of bodies is very necessary, as many of these are distinguished by this physical property. Thus the human blood globules, presenting a biconcave round disk, are in this respect different from the oval corpuscles of the camelidæ, of birds, reptiles, and fishes. The distinction between round and globular is very

necessary to be attended to. Human blood corpuscles are round and flat, but they become globular on the addition of water. Minute structures seen under the microscope may also be likened to the shape of well known objects, such as that of a pear, balloon, kidney, heart, etc. etc.

2. *Colour.*—The colour of structures varies greatly, and often differs, under the microscope, from what was previously conceived regarding them. Thus the coloured corpuscles of the blood, though commonly called red, are in point of fact yellow. Many objects present different colours, according to the mode of illumination,—that is, as the light is reflected from, or transmitted through their substance, as in the case of certain scales of insects, feathers of birds, etc. Colour is often produced, modified, or lost, by re-agents, as when iodine comes in contact with starch corpuscles, when nitric acid is added to the granules of chlorophyle, or chlorine water affects the pigment cells of the choroid, and so on.

3. *Edge or Border.*—The edge or border may present peculiarities which are worthy of notice. Thus it may be dark and abrupt on the field of the microscope, or so fine as to be scarcely visible. It may be smooth, irregular, serrated, beaded, etc. etc.

4. *Size.*—The size of the minute bodies, fibres, or tubes which are found in the various textures of animals, can only be determined with exactitude by actual measurement, in the manner formerly described. It will be observed, for the most part, that these minute structures vary in diameter, so that when their medium size cannot be determined, the variations in size from the smaller to the larger should be stated. Human blood-globules in a state of health have a pretty general medium size, and these may consequently be taken as a standard with advantage, and bodies may be described as being two, three, or more times larger than this structure.

5. *Transparency.*—This physical property varies greatly in the ultimate elements of numerous textures. Some corpuscles are quite diaphanous, others are more or less opaque. The opacity may depend upon corrugation or irregularities on the external surface, or upon contents of different kinds. Some bodies are so opaque as to prevent the transmission of the rays of light, when they look black by transmitted light, although they be white, seen by reflected light. Others, such as fatty particles and oil globules, refract the rays of light strongly, and present a peculiar luminous appearance.

6. *Surface.*—Many textures, especially laminated ones, present a different structure on the surface from that which exists below. If, then, in the demonstration, these have not been separated, the focal point must be changed by means of the fine adjustment. In this way the capillaries in the web of the frog's foot may be seen to be covered with an epidermic layer, and the cuticle of certain minute fungi or infusoria to possess peculiar markings. Not unfrequently the fracture of such structures enables us, on examining the broken edge, to distinguish the difference in structure between the surface and the deeper layers of the tissue under examination.

7. *Contents.*—The contents of those structures, which consist of envelopes, as cells, or of various kinds of tubes, are very important. These may consist of included cells or nuclei, granules of different kinds, pigment matter, or crystals. Occasionally their contents present definite moving currents, as in the cells of some vegetables, or trembling rotatory molecular movements, as in the ordinary globules of saliva in the mouth.

8. *Effects of Re-agents.*—These are most important in determining the structure and chemical composition of numerous tissues. Indeed, in the same manner that the anatomist with his knife separates the various layers of a texture he is

examining, so the histologist, by the use of re-agents, determines the exact nature and composition of the minute bodies that fall under his inspection. Thus water generally causes cell formations to swell out from endosmosis; whilst syrup, gum-water, and concentrated saline solutions, cause them to collapse from exosmosis. Acetic acid possesses the valuable property of dissolving coagulated albumen, and, in consequence, renders the whole class of albuminous tissues more transparent. Thus, it operates on cell walls, causing them either to dissolve or become so thin as to display their contents more clearly. Ether, on the other hand, and the alkalies, operate on the fatty compounds, causing their solution and disappearance. The mineral acids dissolve most of the mineral constituents that are met with, so that in this way we are enabled to tell with tolerable certainty, at all events the group of chemical compounds to which any particular structure may be referred.

Any further instruction I could give you, with regard to the microscope as a means of diagnosis, could only consist of a description of the different tissues in their healthy and diseased conditions. With this view, it is necessary to become acquainted with the structure both of plants and animals, first in their healthy and then in their diseased conditions. This constitutes, as you are aware, a distinct portion of my systematic lectures on the institutes of medicine,—a necessary preliminary branch of education to that of clinical medicine. The subject is also taught *practically* in this university during the summer months; and certainly there are few studies where, owing to the sources of error inherent in the best microscopes, the manual dexterity required, and the difficulties to be overcome, a teacher is more necessary. A phenomenon, which may have puzzled a solitary observer for months, concerning which, even at the termination of that time, he may have arrived at an erroneous conclusion, is, when properly explained, at once understood. Hence why

histology has made such progress in Germany, where practical courses of lectures have been given upon it for many years, and where, in consequence, the young anatomist commences his career with a knowledge which would have astonished the older observers. The researches of Remak on the nerves, of Emmert, of the younger Burdach, and some of the greatest discoveries made in anatomy and physiology, have constituted the subject of the theses published by these observers, on taking their degree of doctor in medicine. Several of our own graduates have recently distinguished themselves in a like manner; and it is satisfactory to know that there is an extensive field for original research open to our alumni, the cultivation of which will actually bind them more closely and intimately with their practical studies.

In conclusion, let me repeat what I have formerly published and frequently stated, namely, that you should regard the microscope only as a means to an end; that in itself it is nothing, and can no more confer the power of observing, reflecting, or of advancing knowledge, than a stethoscope can *per se* enable a physician to discover a disease, or a cutting instrument give the judgment and skill necessary for performing a great operation. We should learn to distinguish between the mechanical means necessary for arriving at truths, and those powers of observation and mental processes which enable us to recognise, compare, and arrange the truths themselves. In short, rather endeavour to observe carefully and reason correctly on the facts presented to you, than waste your time in altering the fashion and improving the physical properties of the means by which facts are ascertained. At the same time, these are absolutely necessary; and perhaps no kind of knowledge has been so much advanced in modern times by the introduction of instruments and physical means of investigation, as that of medicine. These enable the practitioner to extend the limits to which otherwise his senses would be limited, and I claim a place for the microscope beside the stethoscope, pleximeter, speculum, probe,

etc. I do not say employ one to the exclusion of the other, but be equally dexterous in the use of all. Do not endeavour to gain a miserable reputation as a microscopist, or as a stethoscopist; but by the appropriate application of *every* instrument and means of research, seek to arrive at the most exact diagnosis and knowledge of disease, so as to earn for yourselves the title of enlightened medical practitioners.

LECTURE V.

PRINCIPAL APPLICATIONS OF THE MICROSCOPE TO DIAGNOSIS.

A PERFECT application of the microscope, for the purposes of diagnosis, can only be arrived at by obtaining, in the first instance, a complete knowledge of the tissues of plants and animals, both in their healthy and diseased conditions. The medical practitioner may be called upon to distinguish, not only the various structures which enter into every species of food, every kind of animal texture and fluid, and every form of morbid product, but he will frequently have to judge of these when more or less disintegrated, changed, or otherwise affected, by the processes of mastication, digestion, expectoration, ulceration, putrefaction, maceration, etc. etc. In this place, however, I propose merely calling your attention to those points which are more likely to fall under your notice at the bed-side. No doubt, the practical applications of the microscope are daily extending, and whilst there are many points which may be said to be scarcely investigated, those which have been most so require to be further investigated. At the same time, a careful and persevering examination of the morphological elements found in the various excreta of the body, as modified by different diseases, or by constitution and diet, cannot but prove of great importance in the present state of practical medicine. Hence, besides shortly discussing what is known, I shall especially indicate what are those subjects which may be elucidated by such of you whose previous histological observations qualify them for the task.

THE SALIVA.

The readiest way of examining the saliva is to collect a drop of that fluid at the extremity of the tongue, and let it fall on the centre of a slip of glass. It should be allowed to remain quiescent for a minute or so, until most of the bubbles of air have collected in a mass on the surface. This should then be gently scraped off or placed aside with a needle, and the subjacent fluid covered with a thin glass. There will now be observed, with a magnifying power of 250 diameters linear—1st, The salivary corpuscles; 2d, Epithelial scales of the mouth; 3d, Molecules and granules.

1. *The salivary corpuscles* are colourless spherical bodies, with smooth margins, varying in size from the $\frac{1}{3000}$th to the $\frac{1}{1800}$th of an inch in diameter. They contain a round nucleus, varying in size, but generally occupying a third of the cell; and between this nucleus and the cell wall are numerous molecules and granules, which communicate to the entire corpuscle a finely molecular aspect. The addition of water causes these bodies to swell out and enlarge from endosmosis; while acetic acid somewhat dissolves the cell wall, and it becomes more transparent; while the nucleus appears more distinct as a single, double, or tripartite body. Both water and acetic acid also produce coagulation of the albuminous matter contained in the fluid of the saliva, which assumes the form of molecular fibres, in which the corpuscles and epithelial scales become entangled, and present to the naked eye a white film.

Fig. 9.

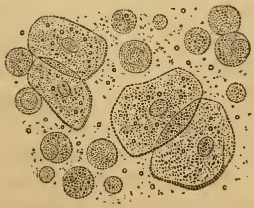


Fig. 9.—Salivary corpuscles, epithelial scales, with molecules and granules, as seen in a drop of saliva.

2. *The epithelial scales* found in the saliva are derived from the mouth, and consist of flat plates, variously shaped, but generally presenting an oblong or squarish form, more or less curled up at the sides. Not unfrequently these have five or six sides, and are assembled together in groups, with their edges adherent. In size they vary from the $\frac{1}{800}$th to the $\frac{1}{500}$th of an inch in length. Embedded in their substance is a round or oval nucleus, together with numerous molecules and granules. Water produces no change in these bodies; but acetic acid renders the scale more transparent, and the nucleus to appear more distinct, with a darker edge.

3. Associated with the salivary corpuscles and epithelial scales are several *molecules and granules*, which vary in number in different people, and at various times of the day.

There may also be occasionally found in the saliva various foreign substances derived from the food,—such as granular debris of different kinds, starch globules or vegetable cells, muscular fasciculi, portions of areolar tissue, tendon, or spiral filaments, etc.,—derived from pieces of texture which have adhered to the teeth during mastication.

The saliva may present various alterations, dependent on disease of the mucous membranes of the mouth and tongue. This, when ulcerated, causes an increase in the molecular and granular matter. Many of the epithelial scales also lose their transparent character and become opaque, from an augmentation of granular matter in their substance. Not unfrequently, under such circumstances, they give rise to confervoid growths, which mainly spring up in the debris collected in the mouth, either on the surface of ulcers, in the sordes which collect on the teeth, gums, and tongue of individuals labouring under fever, or even in the inspissated mucous of persons who sleep for a considerable time with the mouth open. In infants, the tongue and cavity of the mouth are not unfrequently covered with a yellowish flocculent matter, constituting the disease named *muguet* by the French,

in which sporules and confervoid filaments, in a high state of development, may be detected in considerable numbers.

Fig. 10. Fig. 11.

Fig. 10.--Minute confervoid filaments springing from an altered epithelial scale, scraped from the surface of a cancroid ulcer of the tongue.

Fig. 11.—Confervoid filaments and sporules, in the exudation on the mouth and gums, constituting *Muguet* in infants.

In epithelial cancroid of the tongue, the epithelial scales exhibit a great tendency to split up and form fibres, and may frequently be found on the surface of the ulcer presenting the form here figured.

Fig. 12.

Fig. 12.—Fringe-like epithelium, from the surface of an ulcer on the tongue.

Occasionally they exhibit a tendency to form concentric circles, an appearance very common in the substance of the morbid growth, but also occasionally seen in the nodules which are from time to time separated, and found in the saliva.

Fig. 13.

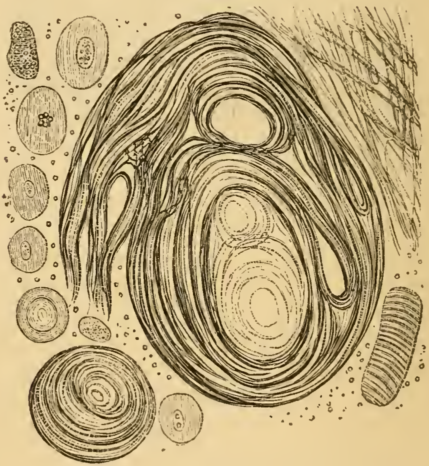


Fig. 13.--Concentric laminæ of condensed epithelial scales, with epithelial cells and fragments of muscular fasciculi, from a cancroid ulcer of the tongue.

An histological examination of the saliva, of the fur and load of the tongue, in the great majority of diseases, is still a desideratum.

MILK.

On examining a drop of milk,[1] we observe a number of

[1] The mode of examining all fluids is the same, and is described p. 68; it need not be repeated.

bodies rolling in a clear fluid. These bodies, in healthy milk, are perfectly spherical, with dark margins, smooth and abrupt on the field of the microscope, with a clear transparent centre, which strongly refracts light. In size they vary from a point scarcely measurable, up to, in different specimens, the $\frac{1}{4000}$th or $\frac{1}{3000}$th of an inch in diameter. In excess of ether they are dissolved or disappear; but if this re-agent be in small quantity, exosmosis takes place, and the field of the microscope is covered with loose globules of oil, of various forms. Water causes the milk globules to swell out, but very slightly. Acetic acid coagulates the caseous fluid in which they swim, and causes the globules to be aggregated together in masses. Several of the globules also exhibit, under the action of this re-agent, a certain flaccidity, and readily run into one another under pressure.

These globules consist of an albuminous delicate envelope, enclosing a drop of oil or butter. The membrane keeps them separate, so long as it is intact; but, dissolved by means of acetic acid, or ruptured by heat or mechanical violence (as in the churn), the butter is readily separated and collected. Cream is composed of the larger of these globules, which, owing to their light specific gravity, float on the surface of milk when allowed to repose.

The richness of milk is determined by the quantity of these globules. An examination of cow's and human milk will at once show that the former contains a larger number than the latter. In all efforts, however, to determine the relative value of milk by microscopic examination, great care must be taken that the drop of fluid examined should be of the same bulk, that the same upper glass should be used in every case, and that it should be applied and pressed down with the same force. It is very difficult at all times strictly to fulfil these conditions, so that not only is great skill in manipulation required, but considerable experience, and an intimate acquaintance with milk as seen under the microscope, necessary, before any confidence can be placed in this mode of

testing the quality of different specimens of the fluid. At the same time, the difference in the amount of oily constituents between the milk of the cow, ass, and human female, may in this way be easily determined.

In the same manner the various adulterations of milk are at once determined. Water, of course, separates the globules more and more from each other according to its amount. Flour will exhibit the large starch corpuscles, which are changed blue by the action of iodine. Chalk shows numerous irregular mineral particles, which are soluble in the mineral acids; and broken-down brain will be distinguished by large oil globules, mingled with fragments of fine nerve-tubes. Milk, when acid, exhibits the same character that it does under the action of acetic acid.

Healthy and fresh milk is indicated by a certain uniformity in the size of the globules; by their perfectly globular form; by their rolling freely over each other, and not collecting together in masses. (Fig. 14.) When the latter circumstance occurs, it is a sign of acidity.

Fig. 14.

Fig. 15.

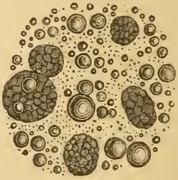


Fig. 14.—Globules of cow's milk.

Fig. 15.—Colostrum of the human female, containing milk globules greatly varying in size, with compound granular corpuscles.

The milk first secreted after parturition is called the colostrum. It is yellow in colour, and may be seen under the microscope to contain globules more variable in size, mingled with a greater or less number of compound granular bodies. (Fig. 15.) These latter ought to disappear in the human

female on the fifth or sixth day after parturition, but occasionally they remain, when the milk must be considered as unhealthy. In some cases I have seen them abundant so late as six weeks after the birth of the infant.

On some occasions, milk may be mixed with pus and blood, which are readily detected by the characters distinctive of each. Dr Peddie has pointed out that milk can be squeezed from the mamma during the early months of pregnancy. Under such circumstances, it constitutes a most important sign of the pregnant state, especially of a first pregnancy; for although the secretion at this time has seldom the external appearance of milk, but is serous-looking, and often very viscid and syrupy, still, if examined with the microscope, the characteristic milk globules will at once appear. See his valuable paper, "Monthly Journal of Medical Science," August 1848.

THE BLOOD.

On examining a drop of blood drawn from the extremity of the finger by pricking it, there will be seen a multitude of yellow, round, bi-concave discs, rolling in the field of the microscope, which soon exhibit a tendency to turn upon their edge, and arrange themselves in rolls, like rouleaux of coins. These rouleaux, by crossing one another, dispose themselves in a kind of net-work, between which may be seen a few colourless spherical corpuscles, having a molecular surface, and a few granules. The coloured blood-corpuscles vary in size from the $\frac{1}{5000}$th to the $\frac{1}{3000}$th of an inch in diameter, their average size being about the $\frac{1}{4000}$th of an inch—according to Gulliver, $\frac{1}{3200}$th of an inch. Owing to their bi-concave form, they present a bright external rim with a central shadowed spot, or a bright centre and a dark edge, according to the focal point in which they are viewed. (Fig. 16.) If the blood be exposed to the air a little time before examination, or if it be obtained by venesection, the edges of the

corpuscles may often be observed to have lost their smooth outline, and to have become irregular, notched, serrated, beaded, etc. (Fig. 17.) Long maceration in serum, or other

Fig. 16.

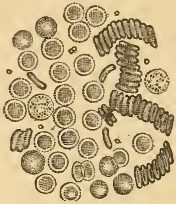


Fig. 17.

Fig. 16.—Blood-corpuscles, drawn from the extremity of the finger. On the left of the figure they are isolated, some flat and on edge, some having a dark and others a light centre, according to the focal point in which they are viewed. On the right of the figure several rolls have formed. Two colourless corpuscles and a few granules are also visible.

Fig. 17.—Blood-corpuscles altered in shape from exosmosis.

circumstances, frequently cause them to diminish in bulk half their natural size, and present a perfectly spherical coloured body. On the addition of water, the blood discs become spherical, and lose their colour. On adding syrup, they become flaccid and irregular. Strong acetic acid dissolves them rapidly, and very weak acetic acid does so slowly, or diminishes their bulk by one-half.

The colourless corpuscles of the blood are spherical in form, and vary in size from the $\frac{1}{2500}$th to the $\frac{1}{2000}$th of an inch in diameter. Their surface presents a molecular or dotted appearance, which almost disappears on the addition of water, when they swell out by endosmosis. Acetic acid renders the external cell wall very transparent, and brings the nucleus into view, consisting of one, two, or three round granules.

The examination of the blood by the microscope enables us to determine certain pathological conditions of that fluid, which, though few in number, are by no means unimportant.

We have seen that, in a healthy condition, the blood possesses very few colourless corpuscles; but there is a certain state, which I have called "Leucocythemia," in which they are very numerous, generally associated with enlargement of the spleen or of the lymphatic glands, or of both. The blood then presents the characters represented in the accompanying figures.

Fig. 18.

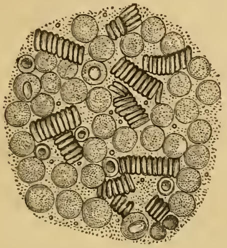


Fig. 19.

Fig. 18.—Appearance of a drop of blood, in Leucocythemia, magnified 250 diameters.

Fig. 19.—The same, after the addition of acetic acid.

Sometimes the colourless corpuscles are only slightly increased in number above the normal standard, as in Fig. 20,

Fig. 20.

Fig. 21.

Fig. 22.

Fig. 20.—Colourless corpuscles slightly increased in number.

Fig. 21.—Colourless corpuscles increased in number, and of small size.

Fig. 22.—The same, after the addition of acetic acid.

which may occur in a variety of dropsical or cancerous affections. Occasionally, though tolerably numerous, they are smaller in size than those represented Fig. 19—as in Fig. 21.

In some rare cases the nuclei of these corpuscles are found naked in the blood, as in cases recorded by Virchow and myself.[1]

Fig. 23.

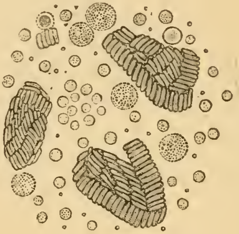


Fig. 24.

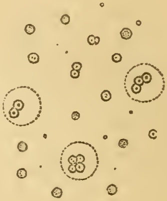


Fig. 23.—Numerous naked nuclei of the colourless corpuscles in the blood.

Fig. 24.—The same, after the addition of acetic acid.

In several diseases, the blood presents unusual spissitude, depending on excess of fibrine. In this condition the coloured blood-corpuscles easily lose under pressure their rounded margin, and assume a caudate or flask-like shape. They do not present their usual tendency to accumulate in rolls, but aggregate themselves together in irregular masses, as represented Fig. 25.

In certain internal hemorrhages the blood-corpuscles break down, or become partially dissolved, when the external envelope is seen very transparent, the shadowed spot disappears, and there is found in their interior one or more granules. The liquor sanguinis also contains an unusual number of

[1] For further information concerning morbid changes in the blood, the author must refer to his work "On Leucocythemia, in relation to the Physiology and Pathology of the Lymphatic Glandular System." Edinburgh, 1852.

granules. (Fig. 26.) The same change is occasionally observable in the blood extravasated below the skin in scurvy or purpura hemorrhagica.

Fig. 25.

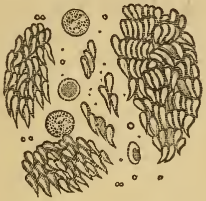


Fig. 26.

Fig. 25.—Blood-corpuscles altered in form, and aggregated together, in thickened blood.

Fig. 26.—Altered blood-corpuscles in the fluid of an hæmatocele.

It has been affirmed, that the colour and number of the corpuscles of the blood undergo a change in plethora, fever, jaundice, dropsies, cholera, etc., but exact observations are wanted to confirm the statement. I have never been able to satisfy myself that any such changes were observable in these diseases by means of the microscope. In chlorosis the number of the blood-globules is undoubtedly diminished; but this is more readily determined by the size of the clot, than by microscopic demonstration.

Occasionally the serum of the blood presents a lactescent appearance; and, on being allowed to remain at rest some hours, a white creamy pellicle forms on the surface. This consists of very minute particles of oil, which resemble the smaller molecules found in milk, and in the chyle.

PUS.

Normal or good pus, when examined under a microscope, is found to consist of numerous corpuscles, floating in a clear fluid, the *liquor puris*. The corpuscles are globular in form, having a smooth margin, and finely granular surface. They

vary in size from the $\frac{1}{1300}$th to the $\frac{1}{1000}$th of an inch in diameter. There may be generally observed in some of them a round or oval nucleus, which is very distinct on the addition of water, when also the entire corpuscle becomes distended from endosmosis, and its granular surface is more or less diminished. On the addition of strong acetic acid the cell wall is dissolved, and the nuclei liberated in the form of two, three, four, or rarely five, granules—each having a central shadowed spot. If, however, the re-agent be weak, the cell wall is only rendered very transparent and diaphanous, through which the divided nucleus is very visible.

Fig. 27.

Fig. 28.

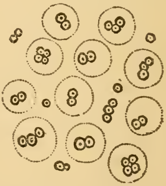


Fig. 27.—Pus corpuscles, as seen in healthy pus.
Fig. 28.—The same, after the addition of acetic acid.

Occasionally these bodies are seen surrounded by another fine membrane, as in Fig. 29. At other times they are not perfectly globular, presenting a more or less irregular margin,

Fig. 29.

Fig. 30.

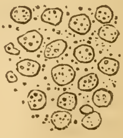


Fig. 29.—Pus corpuscles, surrounded by a delicate cell-wall.
Fig. 30.—Irregular-shaped pus corpuscles, in scrofulous pus.

and associated with numerous molecules and granules. This occurs in what is called scrofulous pus, and various kinds of unhealthy discharges, from wounds and granulating surfaces. In gangrenous and ichorous sores, a few of these irregular pus corpuscles are associated, not only with a multitude of molecules and granules, but with transformed and broken-down blood globules, the debris of the involved tissues, etc. etc.

SPUTUM.

A microscopic examination of the sputum demands a most extensive knowledge of both animal and vegetable structure. I have found in it,—1st, All the tissues which enter into the composition of the lung, such as filamentous tissue, young and old epithelial cells, blood-corpuscles, etc. 2d, Mucus from the œsophagus, fauces, or mouth. 3d, Morbid growths, such as pus, pyoid, and granular cells; tubercle corpuscles, granules, and amorphous molecular matter; pigmentary deposits of various forms, and parasitic vegetations, which are occasionally found in the lining membrane of tubercular cavities. 4th, All the elements that enter into the composition of the food, whether animal or vegetable, which hang about the mouth or teeth, and which are often mingled with the sputum, such as pieces of bone or cartilage, muscular fasciculi, portions of esculent vegetables, as turnips, carrots, cabbages, etc.; or of grain, as barley, tapioca, sago, etc.; or of bread and cakes; or of fruit, as grapes, apples, oranges, etc. All these substances render a microscopic examination of expectorated matters anything but easy to the student.

After considerable experience in the examination of sputum, I think myself warranted in saying, that a knowledge of its minute structural composition is, with few exceptions, of little use in a clinical point of view. The diagnosis of pulmonary diseases is capable of being so accurately determined by percussion and auscultation, that the microscope is, in this respect, of secondary importance.

To examine sputum it should be thrown into water, when, on account of the air it contains, it will generally float on the surface; while the more dense portions, such as masses of crude tubercle or cretaceous concretions, fall to the bottom. It should be then teased, or broken up with a rod, when the various elements and particles it contains will gradually disengage themselves, and may be separated from the mass without difficulty. Nothing is more common, on examining portions of sputum with a microscope, than to observe various aggregations of molecular and granular matter, which present the various appearances here figured.

Fig. 31.

Fig. 32.

Fig. 33.

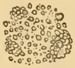


Fig. 34.

Fig. 31.—Mass, consisting of minute molecules, frequently seen in disintegrated tubercle.

Fig. 32.—Mass, composed of molecules and oily granules, varying in size

Fig. 33.—Mass, in which the granules are more or less aggregated together.

Fig. 34.—Mass, in which the particles present the debris of a fibrous structure, as occurs on an ulcerated surface.

Occasionally little masses of a cheesy substance, and yellowish colour, may be found entangled in the purulent mucus, or collected at the bottom of the vessel. These, when examined, present a number of irregular-shaped bodies approaching a round, oval, or triangular form, varying in their longest diameter from the $\frac{1}{120}$th to $\frac{1}{75}$th of a millimetre. These bodies contain from one to seven granules, are unaffected by water, but are rendered very transparent by acetic acid. They are what have been called *tubercle corpuscles.* They are always mingled with a multitude of molecules

and granules, which are more numerous in proportion to the softness of the tubercle. (Fig. 35.)

Sometimes indurated or gritty little masses are brought up with the sputum, which are derived from the cretaceous or calcareous transformation of chronic tubercle in the lungs. They consist of irregular masses of phosphate of lime, combined with more or less animal matter. On squeezing such as are friable between glasses, and examining their structure, they frequently may be seen to contain the elements represented in Fig. 36.

Fig. 35.

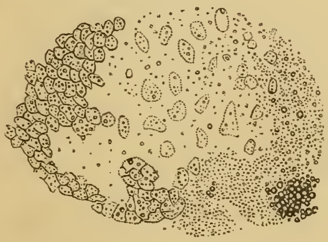


Fig. 36.

Fig. 35.—Tubercle corpuscles and granules, from a softened tubercular mass in the lungs, frequently found in the sputum.

Fig. 36.—Fragments of phosphate of lime, crystals of cholesterine, and tubercle corpuscles, from a cretaceous mass in the lungs, occasionally found in the sputum.

Sputum frequently presents a fibrillated appearance, which is common to all mucous discharges. This is caused by the deposition in viscid mucus of molecules, which assume a linear arrangement. This deposition is increased by the addition of water and acetic acid, so that they consist of albumen. These fine molecular fibres (see Figs. 40, 52) must be separated from the areolar and elastic tissue of the lung, which is not unfrequently found in sputum, indicating ulceration or sloughing of the pulmonary texture. Shroeder van der Kolk has lately stated, that these fragments may be found in the

sputum before the physical signs of ulceration of the lung are well characterised. This fact I have never been able to

Fig. 37.

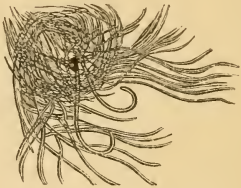


Fig. 37.—Fragment of areolar and elastic tissue of the lung, found in phthisical sputum.

confirm, as, in every case in which they have occurred to me, the physical signs of the disease have been well marked. At the same time it is very possible that in doubtful cases, especially where, from chronic pleurisy or pneumonia, there is dulness on percussion, whilst other physical signs are more or less obscure, the presence of these fragments will confirm a previous suspicion of existing phthisis.

In acute pneumonia, the sputum frequently contains fibrinous casts of the minute bronchi, which present a branched mould of the tubes. These casts may be readily separated in water, as previously described; and when examined with the microscope, are found to consist of molecular fibres, in which pyoid and pus corpuscles are infiltrated.

Fig. 38.

Fig. 38.—Molecular fibres, with corpuscles, in a fibrinous coagulum from a bronchus.

The inspissated sputum, so commonly expectorated in the morning, is derived from the fauces. It often presents a dirty green or brownish colour, passing into black. When

examined with a microscope, it may be seen to consist of epithelial cells, more or less compressed together, and varying in size from the $\frac{1}{2000}$th to the $\frac{1}{800}$th of an inch in diameter. The smaller ones are round, and closely resemble pus corpuscles; the larger ones are round or oval, with a distinct nucleus.

Fig. 39.

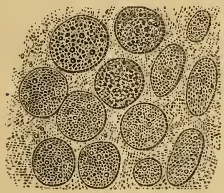


Fig. 40.

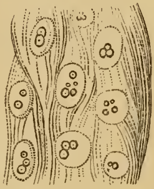


Fig. 39.—Epithelial cells, embedded in mucus, expectorated from the fauces. Some are seen to contain black pigment; others resemble pus corpuscles.

Fig. 40.—Another portion of expectorated mucus from the fauces, acted on by acetic acid, showing fibrillation and the changes in the young cells.

In the dark-coloured portions of this sputum, the cells contain numerous granules and molecules, several of which are black and quite opaque. This black matter consists of carbon, and is unaffected by re-agents. The addition of acetic acid causes coagulation of the mucus in which the cells are embedded; and whilst it produces little change in the older cells, it dissolves, or renders transparent, the walls of such as are young, displaying a round, oval, or divided nucleus, as seen in the figure.

In the black phthisis of colliers the sputum is ink-black, and more or less tenacious. On examination with a microscope, the cells are seen to be loaded with carbonaceous pigment.

Fig. 41.

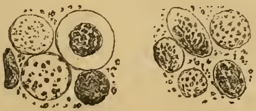


Fig. 41.—Cells loaded with carbonaceous pigment in the sputum of the collier.

Several of these cells are perfectly opaque, whilst others are almost colourless; and between the two extremes there is every kind of gradation as to intensity of blackness. This black pigment is unaffected by the strongest re-agents, nitro-muriatic acid, chlorine, and even the blow-pipe, failing to decompose it. It is, therefore, pure carbon, and differs from the pigment contained in cells of similar appearance in melanotic tumours, as in these latter the re-agents just mentioned at once destroy the colour.

VOMITED MATTERS.

The matters rendered by vomiting have not been made so frequent an object of microscopical observation as is necessary, with a view to diagnosis. In organic diseases of the organ, nothing has been ascertained on this head. In other cases, it almost always happens, that the matters rendered consist—1st, Of the food and drink, in various stages of decomposition and disintegration; 2d, Of alterations in the epithelial lining membrane of the stomach, œsophagus or pharynx, mingled with more or less mucus; 3d, Of certain new formations, which are produced in the fluids of the stomach.

1. It would constitute a very interesting series of observations, to determine, with the aid of the microscope, the structural changes which various articles of food undergo during the process of digestion in the stomach. This has not yet been done with accuracy, although there can be little doubt that compound tissues become disintegrated in the inverse order to that in which they are produced—that is to say, fibres become separated, embedded cells become loose, and, when aggregated together, their cohesion is destroyed. The cell walls then dissolve, the nucleus still resisting the solvent process for some time; but at length the whole is resolved into a molecular and granular mass, which, in its turn, becomes fluid. Such, however, is the different soluble properties of various edible substances, that, in a time suf-

ficient for the perfect solution of some, others are scarcely affected. It may readily be conceived, that the transitions which these substances undergo, may occasionally render their detection difficult; and such is really the case. Starch corpuscles, for instance, break down into rounded granules or molecules, and are very liable to puzzle an inexperienced observer. Tincture of iodine, from its peculiar re-action on these bodies, will always enable us to recognise them.

Fig. 42.

Fig. 42.—Appearance of starch corpuscles after partial digestion in the stomach.

2. The various epithelial cells which line the passages leading to the stomach, as well as the structures peculiar to

Fig. 43.

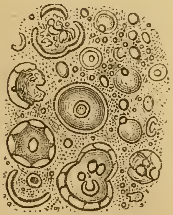


Fig. 44.

Fig. 43.—Structures observed in certain rice-water vomitings from a cholera patient,—showing bodies which consist of the half-digested uredo in bread.

Fig. 44.—Another flake in the rice-water vomiting of a cholera patient, showing, *a*, large epithelial cells; *b*, milk globules, and coagulated caseine; *c*, torulæ; and *d*, half-digested epithelial scales, with liberated nuclei, more or less broken down.

that organ itself, may be found in the vomited matters,—of course mingled with the debris of edible substances. They also may have undergone various changes in appearance, from endosmosis, or even partial digestion. In cholera, the vomited matter consists principally of such altered epithelial cells or scales, many of which are derived from the fauces or œsophagus.

3. The new formations which may be produced in the stomach are principally vegetable fungi—such as various kinds of torulæ (see Fig. 44, *c*), and especially one first discovered in vomited matters by Mr Goodsir, and which he has called, on that account, Sarcina Ventriculi.

Fig. 45.

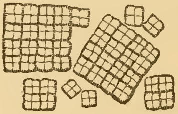


Fig. 45.—Sarcina Ventriculi.

It consists of square particles, which apparently increase by fissiparous division in regular order, so that they present square bundles of four, sixteen, or a multiple of these. Although at first supposed to be peculiar to the stomach, I have frequently found them in the fæces: and in one case, which occurred to Dr Mackay of this city, in the urine. They were also found by Virchow, in an abscess of the lung.

In addition to the bodies alluded to, occasionally observed in vomited matters, they may contain various morbid products, such as blood, pus, and cancer cells, colouring matter of the bile, etc.

FÆCES.

The same difficulty attends the examination of the fæces as of the sputum; for there may be found in it,—1st, All

the parts which compose the structure of the walls of the alimentary canal; 2d, All kinds of morbid products; and, 3d, All the elements which enter into the composition of food. The only difference is, that these last are generally more broken down or disintegrated.

Under certain circumstances, the diagnostic value attached to the examination of the fæces is greater than that of the sputum, or of vomited matters. For instance, when pus or blood globules are detected, we may infer that the more perfect these are, the nearer to the anus did they originate. In examples 4 and 6, I have shown how the detection of certain vegetable structures, used as food, were serviceable in diagnosis; but this subject merits more extensive researches than have hitherto been paid to it.

In typhus, and other putrid fevers, the stools contain masses of large crystals of phosphates or carbonates. In dysentery they are loaded with pus and blood; and the former may also be detected on the surface of fæcal masses when the intestine is ulcerated. There may also be occasionally observed numerous torulæ, and occasionally sarcinæ. In cholera the white stools consist of mucus, in which the debris of epithelial cells are entangled; and as the nuclei of these cells resist disintegration for a long time, these round or oval bodies generally exist in considerable numbers. (Fig. 47.)

Fig. 46.

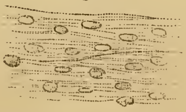


Fig. 46.—Structure of flakes in a rice-water stool, from a cholera patient.

In a disease very common in Edinburgh, especially in women, in which flakes of membranous matter are thrown off from the bowels in large quantities, these present a very similar appearance to the cholera flakes just noticed.

Among the indigestible articles connected with the food, it was observed, in the autumn of 1849, that curious-shaped bodies were detectable, both in the vomited matters and stools of cholera patients. These were supposed to be parasitic formations connected with the cause of cholera, but were pointed out by Mr Busk to be the uredo-segitum, occasionally found in bread.

Fig. 47.

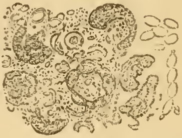


Fig. 47.—Portions of the uredo in bread, still further digested and disintegrated than is observable in the vomited matters. Some torulæ are also present.

On one occasion, a dispensary patient brought to me a membranous mass, which had been evacuated by the bowels. It resembled a piece of boiled fine leather, of a greenish-yellow colour, and fibrous structure. On microscopic examination, it was found to be made up of an extricable mesh-work of confervoid growths, consisting of long tubes, with joints, and a few oval sporules,—the former having a great tendency to break across.

Fig. 48.

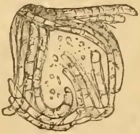


Fig. 49.

Fig. 48.—Structure of confervoid mass passed from the bowels.

Fig. 49.—The same, magnified 500 diameters linear, showing their vegetable nature.

UTERINE AND VAGINAL DISCHARGES.

The diagnostic indications to be derived from the microscopic examination of these discharges, has not been much investigated; but there are few subjects which hold out the promise of more useful results to the medical practitioner. It can only be prosecuted by the obstetric histologist, who, on collecting the secretions poured out from the os uteri, or on the vaginal walls, by means of the speculum, should observe their structural peculiarities when quite fresh.

The menstrual discharge will be found to consist of young epithelial cells, old epithelial scales, and blood globules, the number of which last will be greater or less according to the intensity of the colour. A leucorrhœal discharge always consists of epithelial cells, which may be more or less loaded with fat, combined with numerous young epithelial cells (round or oval), and pus corpuscles.

Fig. 50.

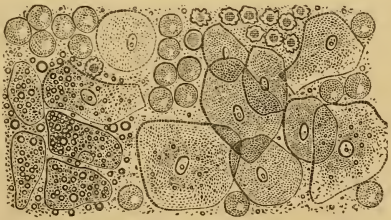


Fig. 50.—Corpuscles seen in a chronic leucorrhœal discharge, consisting of,—1st, Large epithelial scales, from the vagina and cervix uteri. On the left of the figure some of these may be observed to have undergone the fatty degeneration. 2d, Numerous pus corpuscles; and, 3d, blood-globules, the external edges of which are more or less dentated from exosmosis.

The white gelatinous discharge, so frequently seen with the speculum to be derived from the os uteri, consists of ge-

latinous mucus, in which round or oval young epithelial cells are mingled. The mucus is copiously deposited in a molecular form, on the addition of acetic acid or water, whilst the walls of the latter are rendered transparent, and an oval granular nucleus made apparent.

Fig. 51. Fig. 52.

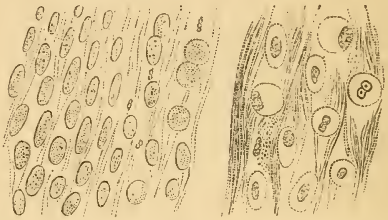


Fig. 51.—Structure of gelatinous mucus from the os uteri.
Fig. 52.—The same, after the addition of acetic acid.

Not unfrequently leucorrhœal and other discharges contain groups of blood-globules, the shapes of which are almost always more or less altered by endosmosis, on account of the viscid fluid mingled with them.—(See Fig. 50.) Indeed, the variations observable in these discharges are dependent for the most part on the excess of one or more of the elements just mentioned, namely, epithelial cells or scales, pus or blood corpuscles, and gelatinous mucus.

In addition to the fluid discharges poured out from the uterus and vagina, there are a variety of morbid growths connected with these organs, the diagnosis of which may be materially facilitated by microscopic examination. The separation of fibrous, epithelial, and cancerous tumours and ulcers, belong to this category, which must be conducted on the general principles referable to the diagnosis of morbid growths in general. By the kindness of Dr Simpson, I have had abundant opportunities of satisfying myself of the importance of this mode of proceeding, in cases where the substance,

mucous surface, or cervix of the uterus, has been more or less involved.

Fig. 53.

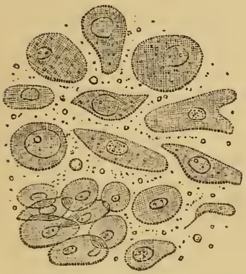


Fig. 54.

Figs. 53 and 54.—Two specimens of cancerous juice squeezed from the uterus.

MUCUS.

In all fluids secreted from a mucous membrane, many of which have been noticed, there may be found a gelatinous material, which has long been called mucus. It may vary in colour from a milk-white to a yellowish brown or even black tint, these variations being dependent on the cell structures or pigment it contains. By some it has been supposed that there are certain cell formations peculiar to mucus, which have been called "mucus corpuscles," but it has always appeared to me that the various bodies found in this secretion are either different forms of epithelium on the one hand, or pus cells on the other. Thus the round epithelial cells found in mucus crypts, or the bodies constituting permanent epithelium, when newly formed; before they have had time to flatten out, and perhaps more or less affected by endosmosis, are represented, Figs. 40 and 52. These are the mucous corpuscles of some writers. Again, when exudation is poured

out on a mucous surface, and is mingled in greater or less quantity with the gelatinous secretion, it presents a marked tendency to be transformed into pus corpuscles, and hence why all irritations of mucous surfaces are usually accompanied by purulent discharges. The pus corpuscles, under such circumstances, present all the characters formerly noticed as peculiar to these bodies. (See Figs. 28 and 40.)

Hence, properly speaking, there is no such body as a mucous corpuscle, the cells found in mucus being either epithelial or pus cells, the number of which present, communicates certain peculiarities to the discharge. Thus, as we have seen, the white gelatinous mucus discharged from the os uteri contains the former, whilst the peculiar fluid characteristic of a gonorrhœa or catarrh, in either sex, abounds in the latter. The gelatinous substance, however, in which these bodies are found, is what is peculiar to the fluid secreted from mucous surfaces, containing, as it does, a large amount of albumen, possessing a remarkable tendency to coagulate in the form of molecular fibres. When recent, these are few in number, but on the addition of water or acetic acid they are precipitated in such numbers as to entangle the cell formations, and present a semi-opaque membranous structure. (Figs. 40, 46, and 52.)

The more healthy a mucous secretion, the more it abounds in this viscous albuminous matter, and the less are its cell elements. On the other hand, when altered by disease, the cell elements increase, and the viscosity diminishes.

DROPSICAL FLUIDS.

The fluids obtained by puncture of dropsical swellings, may in some cases, when examined microscopically, present peculiarities worthy of notice. Thus in the serum collected within the tunica vaginalis testis, numerous spermatozoa may be found, constituting what has been called spermatocele. How these bodies find their way into this fluid is unknown, as no

direct communication with the substance of the testicle has ever been seen; neither does their occurrence seem to inter-

Fig. 55.

Fig. 55 —Spermatozoa as observed in the fluid of Spermatocele.

fere in any way with the successful treatment of this kind of dropsy, by injections, as practised in hydrocele.

In the fluid of ascites, when removed from the body, there may usually be observed a few epithelial scales from the serous layer of the abdomen, which are more abundant in some cases than in others. Occasionally blood and pus corpuscles may be detected in greater or less quantity.

In ovarian dropsy, various products may be found in the evacuated fluid, according to the nature of the contents of the cyst. Pus and blood corpuscles are common elements, but

Fig. 56.

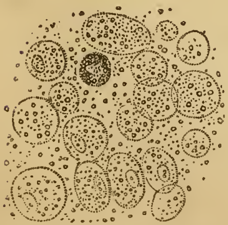


Fig. 57.

Fig. 58.

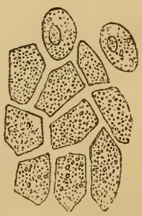


Fig. 56.—Cells in fluid, removed from an ovarian dropsy.
Fig. 57.—The same, after the addition of acetic acid.
Fig. 58.—Group of similar cells, many-sided from compression.

more commonly epithelial cells and scales, which occasionally accumulate in the cysts of ovarian tumours. At other times,

Fig. 59. Fig. 60.

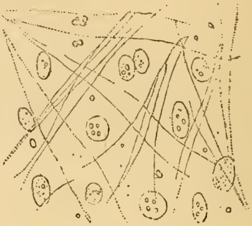
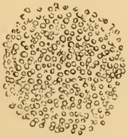


Fig. 59.—Group of oval corpuscles in the gelatinous matter of ovarian dropsy.

Fig. 60.—Round and oval corpuscles, with fibres in another gelatinous mass.

masses of gelatinous or colloid matter are evacuated, which may present various appearances, according to the time it has been secreted. Occasionally it exhibits a faintly fibrous

Fig. 61. Fig. 62.



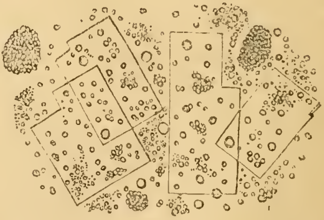


Fig. 61.—Fatty granules occasionally found in colloid masses, taken from an ovarian tumour.

Fig. 62.—Fatty granules, and compound granular cells, with crystals of cholesterine, frequently found in similar masses. The exact angle of the crystals has not been well copied by the artist.

structure, the large meshes of which are filled with transparent jelly, in which round or oval corpuscles, isolated or in groups, may be seen as represented in Figs. 59, 60. Occasionally this substance is more or less opaque, and, on examination, will be found to consist sometimes of fatty granules, either alone or combined with the flat characteristic crystals of cholesterine. Figs. 61, 62.

In the examination of dropsical fluids, also, there can be little doubt that further research will lead to very important results in diagnosis.

URINE.

Healthy human urine examined with the microscope, when recently passed, is absolutely structureless. Allowed to repose for twelve hours, there is no precipitate—occasionally, however, a slight cloudy deposition may be observed, in which may be discovered a few epithelial scales from the bladder, a slight sediment of granular urate ammonia, or a few crystals of triple phosphate. In certain derangements of the constitution, however, various substances are found in the urine, which, in a diagnostic point of view, are highly important, and which we shall shortly notice in succession.

To examine the deposits found in urine, this fluid should be poured, in the first instance, into a tall glass jar; then decant the clear liquid, and put the lower turbid portion into a tall test tube, and again allow the deposit to form. In this manner the structural elements accumulate in the smallest possible compass, and a large number of them are brought into the field of the microscope at once. The *quantity* of any salt or deposit in the urine can never be ascertained by the microscope, but only by the amount of sediment visible, or more accurately by chemical analysis. But in the great majority of cases, the appearances observed under the microscope are sufficient in themselves to distinguish the *nature* of the various kinds of sediment met with, and

these consequently are all that need be described in this place.

Uric Acid.—Uric acid crystals are almost always coloured, but the tint varies from a light fawn to a deep orange red. The general colour is yellow. They present a great variety of forms, the most common being rhomboidal. The lozenge-shaped and square crystals, which are more rarely

Fig. 63.

Fig 64.

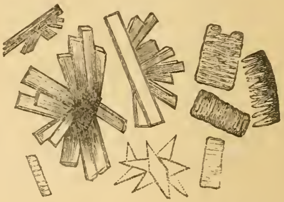


Fig. 63.—Lozenge-shaped and rhomboidal crystals of uric acid.
Fig. 64.—Aggregated and flat striated crystals of uric acid.

met with, isolated and in groups, are represented, Fig. 63. Not unfrequently they present adhering masses or flat scales with transverse or longitudinal markings, as seen Fig. 64. Occasionally they assume the form of truncated rounded columns, as represented, with other structures, Fig. 69.

Urate of Ammonia most commonly assumes a molecular and granular form, occurring in irregular aggregated amorphous masses. Fig. 66. This may be separated from a similar looking deposit of phosphate of lime by the action of dilute muriatic acid, which immediately dissolves the last-named salt, but acts slowly on urate of ammonia, setting free the uric acid. Sometimes, however, it occurs in spherical bodies of a bister brown colour, varying in size from the $\frac{1}{5000}$th to the $\frac{1}{2000}$th of an inch in diameter. The latter size rarely occurs. Occasionally they assume a stellate form, from needle-like or spicular prolongations coming off from the spherical body.

I have seen both these forms associated, and the former so curiously aggregated together as to assume the appearance of an organic membrane, for which by some it was mistaken, until it was observed to dissolve under the action of dilute nitric acid.

Fig. 65.

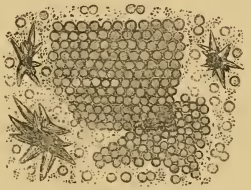


Fig. 65.--Urate of ammonia, in a granular membranous form, and in rounded masses, with spicula.

Triple Phosphate or Ammonio-Phosphate of Magnesia.—These crystals are the most common met with in urine, and are generally well defined, presenting the form of triangular prisms, sometimes truncated, at others having terminal facets. If an excess of ammonia exist, or be added artificially, they present a star-like or foliaceous appearance, which, however, is seldom seen at the bed-side.

Most of the forms of urate of ammonia are represented in the following figure, associated with the triple phosphate.

Fig. 66.

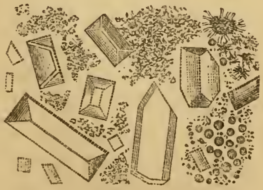


Fig. 66.--Triple phosphate, with various forms of urate of ammonia.

Oxalate of Lime most commonly appears in the form of octohedra, varying in size, the smaller aggregating together in masses. Once seen, these bodies are readily recognised. (Fig. 67.) Very rarely they present the form of dumb bells, or an oval body, the central transparent portion of which presents a dumb bell shape, while the shadowed dark portion fills up the concavities.

Fig. 67.

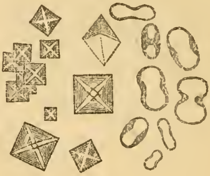


Fig. 67.--Octohedral and dumb-bell shaped crystals of oxalate of lime.

Cystine forms flat hexagonal plates, presenting on their surface marks of similar irregular crystals. Occasionally the centre is opaque, with radiations more or less numerous, passing towards the circumference.

Fig. 68.

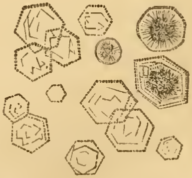


Fig. 68.--Flat crystals of cystine.

In addition to the various salts found in the urine, there may occasionally be found different organic products, such as blood and pus corpuscles, spermatozoa, vegetable fungi, exudation casts of the tubes, or epithelial scales from the bladder,

or mucous passages. Frequently one or more of these are found together, as in the following figure:—

Fig. 69.

Fig. 69.—Bodies observed in the urine of a scarlatina patient, 24 hours after being passed. *a*, Desquamated fragment of uriniferous tube. *b*, Exudation casts of uriniferous tubes. *c*, Amorphous urate of ammonia. *d*, Columnar crystals of uric acid. *e*, Blood corpuscles. *f*, Pus corpuscles. *g*, Torulæ and vegetable fungi, which had been formed since the urine was excreted.

Spermatozoa are occasionally found in the urine, but must not be considered as of any importance, unless accompanied by the peculiar symptoms of spermatorrhœa. (See Fig. 55.) Very rarely casts of the tubes, principally composed of oily granules, may be seen, or epithelial cells, more or less loaded with similar granules, several of which also float loose in the urine, as in the following figure:—

Fig. 70.

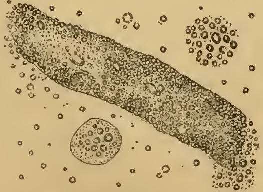


Fig. 70.—Cast of a uriniferous tube, principally composed of oil granules, with fatty epithelial cell and free oil granules, in urine of Bright's disease.

Although these casts of the tubes were at one time confounded together, they may now be separated into at least two distinct kinds, namely,—1st, Fibrinous or exudation casts (Fig. 69 *b*), which are most commonly found in the urine at critical periods of acute inflammations, especially in scarlatina, small-pox, pneumonia, etc. 2d, Casts, with oily granules, indicative of chronic disease, and especially of Bright's disease. (Fig. 70.) At the same time, it should be understood that they may be more or less associated together, and that the rule is not invariable.

All the various appearances noticed, are only diagnostic when accompanied by concomitant symptoms. Alone, they are not to be depended on; but, in combination with the history, and accompanying phenomena, are capable of affording the greatest assistance in the detection of disease.

CUTANEOUS ERUPTIONS AND ULCERS.

An examination of the various products thrown out upon the skin in the different forms of eruption, ulcer, and morbid growth, may in many cases be of high diagnostic value. Of these we shall speak separately.

1. *Cutaneous Eruptions.*—In the vesicular and pustular diseases, there may be observed below the epidermis all the stages of pus formation, commencing in exudation of the liquor sanguinis, gradual deposition of molecular and granular matter, and formation around them of cell walls. The eruption produced artificially by tartar emetic ointment offers the best opportunity of examining the gradual formation of these bodies under the microscope. Pus taken from all kinds of eruptions and sores presents the same characters, there being no difference between the pus in impetigo and that in variola. When a scab is formed, as in eczema or impetigo—a small portion of it broken down, mixed with water and examined under the microscope, presents an amorphous collection of granules, oil globules, and epithelial scales.

The squamous eruptions of the skin are three in number, —namely, psoriasis, pityriasis, and icthyosis. The dry incrustations which form on the surface in these diseases, essentially consist of epidermic scales more or less aggregated together. They are very loose in pityriasis, and occasionally mingled with debris of vegetable confervæ, similar to what grows on the mucous membrane of the mouth. (Fig. 11.) The scales are more aggregated together in psoriasis, and greatly condensed in icthyosis; occasionally in the latter disease presenting the hardness and structure of horn.

The epidermic tumours of the skin assume the form of corns, callosities, condylomatous warts, and what has been called veruca Achrocordon. They all consist, in like manner, of epidermic scales more or less condensed together; in the latter growth they surround a canal furnished with blood vessels. Sometimes they entirely assume a regular form, their interior being more or less hard, fibrous, and vascular, —in short, a prolongation of the epidermis. At other times they soften on their summits, and assume the structural peculiarities of the epithelial ulcer afterwards to be described.

Fig. 71.

Fig. 71.—The summit of a papilla from an epidermic growth, the result of a burn. Each papilla consisted externally of numerous epidermic scales distinctly nucleated, compressed together. Internally it was composed of fibrous vascular tissue.

The favus crust is composed of a capsule of epidermic scales,

lined by a finely granular mass, from which millions of cryptogamic plants spring up and fructify. The presence of these parasitic vegetations constitutes the pathognomonic character of the disease.

In order to examine the natural position of these vegetations microscopically, it is necessary to make a thin section of the capsule, completely through, embracing the outer layer of epidermis, amorphous mass, and light friable matter found in the centre. It will then be found, on pressing this slightly between glasses, and examining it with a magnifying power of 300 diameters, that the cylindrical tubes (*thalli*) spring from the sides of the capsule, proceed inwards, give off branches dichotomously, which, when fully developed, contain, at their terminations (*mycelia*), a greater or less number of round or oval globules (*sporidia*). These tubes are from the $\frac{1}{400}$ to $\frac{1}{600}$ of a millimetre in thickness, jointed at irregular intervals, and often contain molecules, varying from $\frac{1}{10,000}$

Fig. 72.

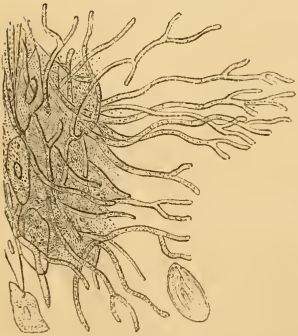


Fig. 73.

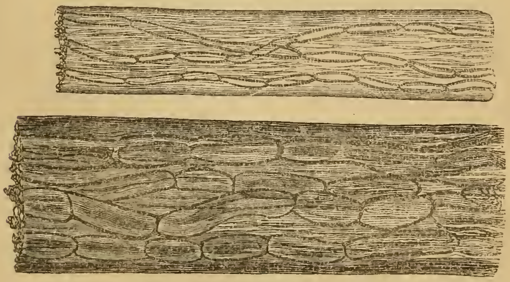
Fig. 72.—Branches of the *Achorion Schoenleini*, in an early stage of development, growing from a molecular matter, and mingled with epidermic scales, from a very minute favus crust.

Fig. 73.—Fragments of the branches more highly developed, with numerous sporules and molecular matter, from the centre of an advanced favus crust. (Magnified 300 diameters linear.)

to $\frac{1}{1000}$ of a millimetre in diameter. The longitudinal diameter of the sporules is generally from $\frac{1}{300}$ to $\frac{1}{100}$, and the transverse from $\frac{1}{300}$ to $\frac{1}{150}$ of a millimetre in diameter (Gruby). I have seen some of these, oval and round, twice the size of the others. The long diameter of the former measured $\frac{1}{75}$ of a millimetre. The mycelia and sporules agglomerated in masses are always more abundant and highly developed in the centre of the crust. The thalli, on the other hand, are most numerous near the external layer. There may frequently be seen swellings on the sides of the jointed tubes, which are apparently commencing ramifications.

On examining the hairs which pass through the favus crusts, it will often be found that they present their healthy structure. At other times, however, they evidently contain long, jointed branches, similar to those in the crust, running in the long axis of the hair, which is exceedingly brittle. I have generally found these abundant in very chronic cases; and on adding water, the fluid may be seen running into these tubes by imbibition, leaving here and there bubbles of air, more or less long. There can be very little doubt, that the tubes and sporules after a time completely fill up the hair

Fig. 74.



a

b

Fig. 74 —*a*, A light hair, containing branches of the *Achorion Schoenleini* —(magnified 300 diameters linear). The wood-cutter has made the branches too beaded. *b*, A darker coloured hair, containing branches of the plant—(magnified 800 diameters linear.)

follicle, and from thence enter the hair, causing atrophy of its bulb, and the baldness which follows the disease. The various steps of this process, however, I have been unable to follow, never having had an opportunity of observing favus in the dead scalp, and of making proper sections of the skin.

The skin is also attacked by certain animal parasites. Of these the pediculi, or lice, are too well known to need description. But we may shortly allude to the Acarus scabiei, and the Entozoon folliculorum.

The *Acarus Scabiei* (see Fig. 75.) has been proved by the recent researches of M. Bourguignon to be the undoubted cause of itch. The male is about a third smaller than the

Fig. 75.

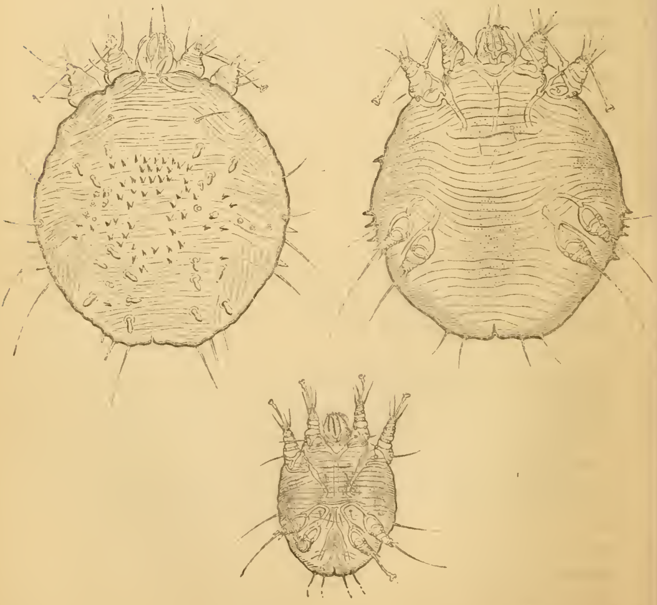


Fig. 75.—Female and male Acarus Scabies magnified 100 diameters (*after Bourguignon*

female. He has suckers on two of his hind feet, and possesses on the abdominal surface genital organs, all of which characters are absent in the female. She, on the other hand, in addition to her size, and the negative marks alluded to, is characterised by the three kinds of horny spines which are scattered over the back. The suckers, or ambulacria, are organs of locomotion; the mandibles enable it to cut the epidermis, and extract fluid from the tissues, which passes through a delicate œsophagus, the internal termination of which is unknown, the body of the animal being apparently filled with an unorganised, very finely molecular pulp. A short delicate tube may also sometimes be observed at the anus—a supposed rectum. No respiratory apparatus can be discovered, although the creature may be seen to swallow minute bubbles of air, which pass down the œsophagus, and, like the nutritive juices, diffuse themselves through the interior. At all events, animal juice and air are both necessary to the life of the Acarus.

The male is more agile than the female, and may be observed to run about on the surface, plunging his head now and then into the skin to extract nourishment. But he never buries his body in holes or furrows as the female does, in order to deposit her eggs. In number the male is to the female as one to ten. He was first discovered by Eichstedt, subsequently by Lanquetin, and has been carefully studied, described, and figured by Bourguignon.

The habits of these insects account for the well known tegumentary irritation of persons affected with itch, when they get warm in bed or approach a fire. It appears that both males and females are active when the infected individual enjoys a certain elevated temperature. The males and young females then run about, and feed themselves by puncturing the skin and swallowing the juices and blood globules. It is then also that the mothers burrow into the epidermis, cutting with their mandibles, and pushing their bodies forward with the assistance of the spines on their backs.

which serve as *points d'appui,* and so form grooves which advance at about the rate of one-twelfth of an inch each night. The male, besides hunting for food, is very active in paying attention to his female friends, carefully avoiding, however, such as are about to become mothers. All these various operations sufficiently account for the itching on the surface of the skin, as well as the tingling and occasional stinging sensations often experienced.

The *Entozoon Folliculorum* inhabits the sebaceous follicles of the skin, and is very common in the face, more especially

Fig. 76.

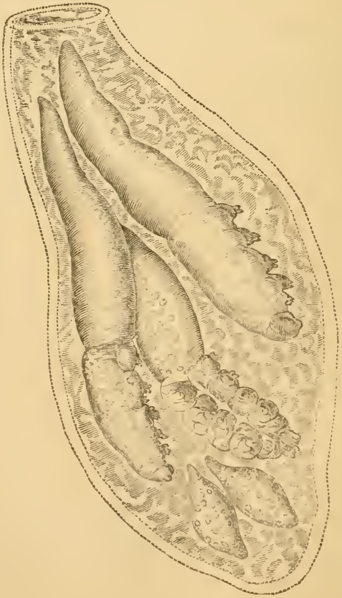


Fig. 76.--Cul-de-sac of a sebaceous follicle, containing three animalcules in different positions, and two eggs. Magnified 350 diameters (*after Gruby*).

when the seat of acne. In the follicles of the nose they are present in the majority of living persons, and, according to Simon, are almost universal in dead bodies. He frequently found them living six days after the death of the individual in whom they were found. The animal measures from $\frac{1}{135}$th to $\frac{1}{64}$th of an inch in length, and from $\frac{1}{155}$th to $\frac{1}{555}$th of an inch in breadth. It is composed of a head, a thorax, and abdomen.

Fig. 77.

Fig. 77.—Hair and its follicle, in which may be seen the animalcules descending towards the root of the hair, and cul-de-sac of the follicles. Magnified 100 diameters (*after Gruby*).

The *head* represents in form a truncated cone, flattened from above downwards, and directed obliquely downwards from the anterior part of the trunk. The existence of an eye has not been determined. The head is furnished with two maxiliary palpi, which admit of extensive motion. The *thorax* is the broadest part of the animal, and is composed of four segments. In each of these, on each side, are the legs, eight in number. The *abdomen* varies in length, is annulated in structure, admitting of certain movements. Internally, Dr Erasmus Wilson has traced out an ali-

mentary canal, and its termination in an anus, together with a brownish mass he considers to be the liver. No sexual differences have been discovered in them, and they possess no respiratory organs.

The animalcule is easily found by compressing with two fingers the skin we wish to examine, until the sebaceous matter is squeezed out, in the form of a little worm. This matter should be placed in a drop of oil previously heated, then separated with needles, and examined with a microscope magnifying 250 diameters. Their movements are slow, whilst the conformation of their articulations only permits them to move forwards and backwards, like lobsters. (Gruby.) They are nourished by the sebaceous secretion of the follicles.

They most commonly occupy the excretory duct of the follicles, which are often dilated in the places where they are lodged. Their head is always directed towards the base of the gland. When there are many together, they are placed back to back, and their feet are applied against the walls of the duct. When very numerous, they are compressed closely together, and are found deeper in the ducts. They rarely exist, however, at the base of the gland. In young persons they generally vary in number from two to four; in an aged individual, they may be from ten to twenty. (Gruby.)

2. *Cutaneous Ulcers.*—In healthy granulating sores, whilst the surface is covered with normal pus corpuscles (Fig. 27), the granulations themselves present fibre cells in all stages of development passing into fibres (Fig. 78.) In scrofulous and unhealthy sores, the pus is more or less broken down, or resembles tubercle corpuscles. (Fig. 30.)

The epithelial ulcer is very common on the under lip, commencing in the form of a small induration or wart, but rapidly softening in the centre, assumes a cup-shaped depression, with indurated margins, which extend in a circular form more or less over the cheek and chin. An

examination of the softened matter sometimes exhibits epithelial cells, mingled with fibre or fibro-plastic cells, as in Figure 80. At other times the cells are enlarged, flattened out, and more or less loaded with fat molecules

Fig. 78.

Fig. 79.

Fig. 78.—Fibre cells passing into fibres.
Fig. 79.—Fibrous tissue formed from fibre cells.

and granules. (Figure 81.) These growths, though generally denominated cancer, are at once distinguished by a microscopic examination, as may be ascertained by comparing

Fig. 80.

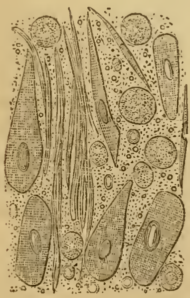


Fig. 81.

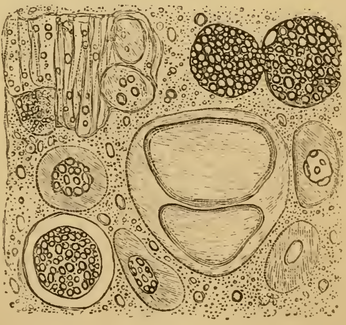


Fig. 80.--Epithelial and fibre cells, from the surface of an ulcer of the lip.
Fig. 81.--Altered epithelial cells, from the surface of another labial ulcer.

the above figures with groups of cancer cells. The so-called chimney-sweep's cancer of the scrotum is essentially a similar formation, consisting externally of flattened epithelial

Fig. 82.

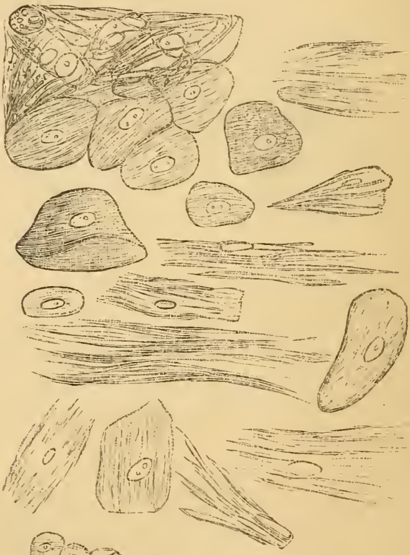


Fig. 83. Fig. 84.

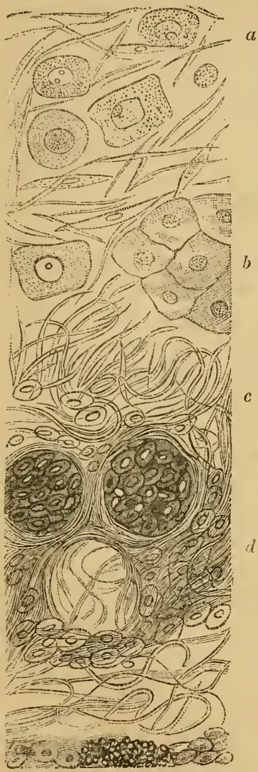
Fig. 82.--Epidermic scales in mass, and isolated from the chimney-sweep's cancer.

Fig. 83.--Group of deeper seated cells.

Fig. 84 --The same, after the addition of acetic acid

scales passing into fibres, and, deeper seated, either groups of younger cells, or concentric layers of aggregated scales, such as those formerly figured in an ulcer of the tongue. (Fig. 13.)

Fig. 85.



The cancerous ulcer of the skin is often difficult to distinguish microscopically from the epithelial ulcer, because the external layer, like it, is often composed of softened epidermis. When, however, a drop of cancerous juice can be squeezed from the surface, it is found to contain groups of cancer cells, which, from their general appearance, may for the most part be easily distinguished. Considerable experience, however, in the knowledge, and skill in the demonstration, of cancerous and cancroid growths, are necessary in order to pronounce confidently on this point, and to this end an acquaintance with the whole subject of the histology of morbid growths is essential.[1]

Fig. 85.—Appearance of section of cancerous ulcer of the skin,—*a*, Epidermic scales and fusiform corpuscles on the external surface. *b*, Group of epidermic scales. *c*, Fibro-elastic tissue of the dermis. *d*, Cancer cells infiltrated into the fibrous tissue, and filling up the loculi of dermis.

[1] See the Author's Treatise on Cancerous and Cancroid Growths. Edin. 1849.

LECTURE VI.

THE CLASSIFICATION AND DIAGNOSIS OF CUTANEOUS DISEASES.

Notwithstanding the great advances which have been made in our knowledge of diseases of the skin, it cannot be denied that very inexact notions prevail regarding this class of disorders. I do not here allude to the eruptive fevers, which, from their frequency and danger, necessarily demand the attention of every professional man, so much as to the lighter and more chronic disorders to which the skin is subject. Ignorance, however, here, although it seldom occasions danger to human life, produces great inconveniences, exasperates the progress of other maladies, renders life miserable, and frequently destroys those social relations and ties which constitute happiness.

A lady was seized with an eruption on the genital organs, which rendered the slightest contact unbearable. Her husband suspected that she laboured under syphilis, and accused her of infidelity. A medical man, who was consulted, pronounced her disease venereal—a separation took place between the parties; the lady always maintaining her innocence, but anxious to escape the unfounded suspicions and ill-treatment of her husband. Mercury and an anti-venereal treatment were continued for some time, but the disease increased in intensity. At length another physician, skilled in the diagnosis of skin diseases, was consulted, who pronounced it to be an *eczema rubrum*, quite unconnected with syphilis; and, on the application of appropriate remedies, a speedy cure confirmed his diagnosis.

A lady in the country sent one of her servants into town, to obtain advice for an eruption which had broken out on her body, and which she was afraid might be communicated to her children. The practitioner consulted was much puzzled, and asked me to see the patient, who, according to him, was labouring under a rare form of skin disease. I found a *herpes zoster* extending round one half the trunk, and told him it would disappear spontaneously in a few days, which it did.

Nothing is more common in practice than to meet with cases among servants, where prurigo has been mistaken for itch, causing great alarm to the family, and much injury to the servant. The various diseases of the scalp also are continually confounded together. Indeed, examples might easily be accumulated, proving the inconvenience which an unacquaintance with skin diseases may occasion both to patient and practitioner. A young medical man is especially liable to be consulted in cases of trifling skin eruptions; and nothing is so likely to establish his credit, as the ready diagnosis and skilful management of such disorders, especially when (as frequently happens) they have been of long standing, and baffled the efforts of older practitioners. Conceiving, then, that this subject deserves more careful consideration than it usually meets with in a clinical course, I propose directing your attention to the classification and general diagnosis of these disorders, as a further introduction to the study of individual cases in the wards.

CLASSIFICATION.

Skin diseases are so various in appearance and in their nature, that many experienced practitioners have endeavoured to facilitate their study by arranging them in groups.

There are three kinds of classification which deserve notice:—1st, The artificial classification of Willan; 2d, The natural arrangement of Alibert; and 3d, A pathological arrangement founded on the supposed morbid lesions.

Of these, the best, and the one which most facilitates the study of cutaneous diseases, is certainly that of Willan. No doubt it has its faults and inconveniences, but many of them have been removed by Biett. This classification is founded upon the character presented by the eruption, which, when once known, determines the disease. It is an old saying, that it is much easier to play the critic and to find fault, than to construct something better. This remark may be well applied to those who have ventured to set aside Willan's arrangement, and bring forward others. The natural classification of Alibert can never be followed by the student, and presupposes a considerable knowledge of the subject. The pathological arrangement again is decidedly faulty. The morbid anatomy and pathology of many skin diseases are unknown; how, then, can we found a classification upon them? Indeed, the very principles on which such classifications are based, are continually undergoing changes as pathology advances.

On the whole, therefore, the arrangement best suited to the student and for practical purposes is that of Willan and Bateman, with the modifications introduced into it by M. Biett.

Definitions.—Before we can proceed to refer any particular disease to its appropriate class, we must be acquainted with the characteristic appearances which distinguish the different orders. They are as follows:—

1. *Exanthema* (Rash).—Variously formed irregular sized superficial red patches, which disappear under pressure, and terminate in desquamation.

2. *Vesicula* (Vesicle).—A small, acuminated, or orbicular elevation of the cuticle, containing lymph, which, at first clear and colourless, becomes often opaque or pearl-coloured. It is succeeded either by scurf or a laminated scab.

3. *Bulla* (Bleb).—This differs from the vesicle in its size, a large portion of the cuticle being detached from the skin by the interposition of a watery fluid, usually transparent.

4. *Pustula* (Pustule).—A circumscribed elevation of the

cuticle, containing pus. It is succeeded by an elevated scab, which may or may not be followed by a cicatrix.

5. *Papula* (Pimple).—A small, solid, acuminated elevation of the cuticle, in appearance an enlarged *papilla* of the skin, commonly terminating in scurf, and sometimes, though seldom, in slight ulceration of its summit.

6. *Squama* (Scale).—A lamina of morbid cuticle, hard, thickened, whitish, and opaque, covering either small papular red elevations, or larger deep-red, dry surfaces.

7. *Tubercula* (Tubercle).—A small, hard, indolent, primary elevation of the skin, sometimes suppurating partially, sometimes ulcerating at its summit.

8. *Macula* (Spot).—A permanent discolouration of some portion of the skin, often with a change of its structure. These stains may be white or dark-coloured.

The different appearances thus described characterise the eight orders of Willan and Bateman, viz. 1. Exanthemata; 2. Vesiculæ; 3. Bullæ; 4. Pustulæ; 5. Papulæ; 6. Squamæ; 7. Tuberculæ; 8. Maculæ. The principal modifications made by Biett are removing from these groups certain diseases which have no affinity with them, and constituting them into extra orders of themselves. Thus he makes altogether fifteen orders, as seen in the following classification given by his pupils Schedel and Cazenave, which also indicate the subdivisions into which each order is divided:—

ORDER I.—*Exanthemata.*
Rubeola.
Scarlatina.
Erythema.
Erysipelas.
Roseola.
Urticaria.
ORDER II.—*Vesiculæ.*
Eczema.
Herpes.
Scabies.
Miliaria.
Varicella.
ORDER III.—*Bullæ.*
Pemphigus.
Rupia.
ORDER IV.—*Pustulæ.*
Variola.
Vaccinia.
Ecthyma.
Impetigo.
Acne.
Mentagra.
Porrigo.
Equinia.
ORDER V.—*Papulæ.*
Lichen.
Prurigo.
ORDER VI.—*Squamæ.*
Psoriasis.
Pityriasis.
Icthyosis.
ORDER VII.—*Tuberculæ.*
Lepra Tuberculosa.
Lupus.
Molluscum.
Framboesia.
Cheloidea.
ORDER VIII.—*Maculæ.*
Lentigo.
Ephelides.
Nævi and Vitiligo.
ORDER IX.—*Purpura.*
X.—*Pellagra.*
XI.—*Radesyge.*
XII.—*Lepra Astrachanica*
XIII.—*The Aleppo Evil,* or *Malum Alepporum.*
XIV.—*Elephantiasis Arabica.*
XV.—*Syphilidæ,* or *Syphilitic Eruptions.*

Even this classification is very complicated, and appears to me to admit of still further modifications, which will render the subject more simple and practical at the bed-side. I shall point out to you, in the first instance, the reasons which have induced me to make these modifications, and then give, in a tabular form, the classification which we shall in future adopt.

In the orders *Exanthemata* and *Pustulæ*, we find several diseases which are characterised by excessive fever, so that they have long been spoken of under the term of eruptive fevers, as well as under that of febrile eruptions. With them, in short, fever is the characteristic, and they are influenced by laws of a peculiar character, altogether different from those which regulate the production of other cutaneous affections. I propose, then, removing these disorders from the category of skin diseases altogether, which will only leave three in the first order, namely, erythema, roseola, and urticaria. I am aware that, strictly speaking, these may be accompanied by slight fever, which may also occur in several other skin diseases. But I do not pretend to form a classification which is perfect, or even pathological, but one which some experience in the teaching of these diseases has convinced me is useful and practical for the student.

In the order *Vesiculæ* we find five diseases. I propose cutting out miliaria, as being very unimportant, and a trifling sequela of fevers. Varicella I believe to be a modified small-pox, and I omit it for the same reasons as I do variola. Scabies, on the other hand, though dependent upon the presence of an insect, the *Acarus Scabiei*, presents such distinct characters as to warrant its retention.

I propose expunging the order *Bullæ* altogether. We find in it two diseases. The first of these, pemphigus or pompholyx, is a vesicular disease in every point, appearing in successive crops, and forming a laminated scab. Rupia, on the other hand, is evidently a pustular disease, forming a prominent scab, producing ulceration, and leaving a cicatrix.

I shall, therefore, add pemphigus to the order vesiculæ, and rupia to that of the pustulæ.

From the *Pustulæ*, for the reasons formerly stated, I expunge variola, vaccinia, and equinia. Mentagra, so far as I have been able to study it in this country, has always consisted of eczema or impetigo on the chin of the male. In syphilitic cases, it is more or less tubercular, and it has been described also as consisting of a vegetable parasite. Although I have never seen the appearance figured by Cazenave (Plate 16), I can understand that such a mentagra might really consist of vegetable fungi. At all events, mentagra is not a special pustular disease. Porrigo means any eruption on the head, whether vesicular, pustular, or squamous. Favus, to which it has long been applied, is undoubtedly a vegetable parasite, and ought, with others of a like nature, to constitute a class of themselves. Moreover, it is neither vesicular nor pustular. Hence the class of pustulæ will with us contain only impetigo, ecthyma, acne, and rupia.

The orders *Papulæ* and *Squamæ* remain the same. The strophulus of many English writers is certainly only lichen occurring in the child ; and what has been called lepra, as distinguished from psoriasis, is the latter disease presenting an annular form.

From the class *Tuberculæ* I cut out frambœsia, as being a disease unknown in this country, together with cheloidea, which, as I understand it, means either cancer or tubercle of the skin.

As regards the order *Maculæ*, I place in it, as did Willan, purpura, because, although sometimes it may depend on constitutional causes of an obscure nature, and at others be allied to scurvy, it still, in an arbitrary classification of this kind, constitutes an undoubted spot or macula.

All the other orders of Biett I shall take the liberty of expunging—pellagra, lepra Astrachanica, and malum Aleporum, are unknown in this country. I agree with Hebra in thinking that radesyge is only a modified form of lupus. The elephantiasis Arabica is an hypertrophy of the areolar

tissue or chorion, and belongs more to the subject of fibrous growths than that of skin diseases. Syphilitic diseases I do not regard as a distinct order, but as any of the ordinary skin affections, more or less modified by a peculiar state of the constitution.

Whilst I have cut out many diseases from the eight orders originally established by Willan, and subsequently modified by Biett, I find it necessary to add two orders, which the advance of pathology and histology shows ought to be considered apart. I allude to those which depend on the presence of parasitic animals and plants, and which may be called respectively *Dermatozoa* and *Dermatophyta.* It has now been shown by M. Bourguignon, that scabies is dependent on the presence of an acarus, but that the insect is only indirectly the cause of the eruption. Hence I put acarus among the dermatozoa, although it certainly forms, when present, a constituent of itch. Among the dermatophytes will be placed favus and mentagra,—both removed from the class pustulæ. Other diseases, such as plica Polonica, and pityriasis, have been considered as parasitic, but the former is unknown in this country, and the latter, though frequently presenting epiphytes among the scales, owes none of its essential characters to this circumstance.

The classification, then, we shall in future adopt is as follows:—

ORDER I.—*Exanthemata.*
- Erythema.
- Roseola.
- Urticaria.

ORDER II.—*Vesiculæ.*
- Eczema.
- Herpes.
- Scabies.
- Pemphigus.

ORDER III.—*Pustulæ.*
- Impetigo.
- Ecthyma.
- Acne.
- Rupia.

ORDER IV.—*Papulæ.*
- Lichen.
- Prurigo.

ORDER V.—*Squamæ.*
- Psoriasis.
- Pityriasis.
- Icthyosis.

ORDER VI.—*Tuberculæ.*
- Lepra Tuberculosa.
- Lupus.
- Molluscum.

ORDER VII.—*Maculæ.*
- Lentigo.
- Ephelides.
- Nævi.
- Purpura.

ORDER VIII.—*Dermatozoa.*
- Entozoon folliculorum.
- Acarus.
- Pediculus.

ORDER IX.—*Dermatophytæ.*
- Achorion Schonleini (Favus).[1]
- Achorion Grubii (Mentagra).[1]

[1] It has been objected to the words porrigophyte and mentagraphyte, introduced by Gruby, that they are unclassical; and, as the celebrated

DIAGNOSIS.

The recognition of skin diseases, and the separating one class from the other, is of essential importance to a proper treatment. On this point I fully agree with a recent writer, who says "the treatment of a great many cutaneous diseases is but of secondary importance, compared with their differential diagnosis. Many of them will get well without any treatment, provided they are allowed to pursue their natural course; and, on the contrary, a mild and simple eruption, by being mistaken, from a similarity of external appearances, for one of a severe or rebellious character, and treated accordingly, may be aggravated and prolonged for an indefinite period." (Burgess.) This differential diagnosis, however, to the inexperienced, is a matter of great difficulty, because considerable tact is often necessary, not only to discover the original element each disease presents, such as a rash, vesicle, pustule, scale, and so on, but this is often impossible. Under such circumstances the diagnosis is frequently derived from the scab, or other appearances presented, such as the cicatrix. The whole subject has been rendered very confused and complicated by systematic writers, who have often given different names to the same disease, or unnecessarily divided them into forms and varieties. I advise you not to pay any attention to these forms and varieties for the present, and confine your efforts only to the detection of the diseases enumerated in the table under each order; and with a view of facilitating your endeavours, the following short diagnostic characters and definitions should be attended to.

botanist, Link, after carefully examining these vegetations, has described the former as a new genus, under the head of achorion (from *achor*, the old term given to a favus crust by Willan), I have thought it best to adopt that term. To mark the variety in favus, he has added the name of its discoverer, Scheonlein; and I have ventured, at all events provisionally, to distinguish the one described as existing in mentagra, by adding to it, also that of its discoverer, Gruby.

I. Exanthemata.

1. *Erythema.*—A slight continuous redness of the skin in patches of various shapes and sizes.

2. *Roseola.*—Circumscribed rose-red patches, of a circular, serrated, or annular form.

3. *Urticaria.*—Prominent red patches of irregular form, the centre of which is often paler than the surrounding skin.

II. Vesiculæ.

Eczema.—Very minute vesicles in patches, presenting a shining appearance, yielding a fluid which dries into a laminated or furfuraceous crust. The skin is of a bright red colour.

Herpes.—Clusters of vesicles, varying in size from a millet seed to that of a pea, surrounded by a bright red areola. They yield a fluid which dries into a thin incrustation, that drops off between the eighth and fifteenth day.

Scabies.—Isolated vesicles of an acuminated form, commonly seated between the fingers, and flexor surfaces of the arms and abdomen—never on the face.

Pemphigus.—Large vesicles or blebs (bullæ), surrounded by an erythematous circle, the fluid of which forms, when dry, a laminated crust. When chronic, they appear in successive crops, and the disease is called *pompholyx.*

III. Pustulæ.

Impetigo.—Small pustules, commonly occurring in groups, and forming an elevated crust.

Ecthyma.—Large isolated pustules, depressed or umbilicated in the centre, and leaving a cicatrix.

Acne.—Isolated pustules situated on a hardened base, which form and disappear slowly. They only occur on the face and shoulders.

Rupia.—Large pustules, followed by thick prominent crusts, and producing ulcerations of various depths.

IV. Papulæ.

Lichen.—Minute papulæ occurring in clusters or patches.

Prurigo.—Larger and isolated papulæ generally seated on the extensor surfaces of the body.

V. Squamæ.

Psoriasis.—Whitish laminated scales slightly raised above the reddened surface of the skin.

Pityriasis.—Very minute scales, like those of bran, seated on a reddened surface.

Ichthyosis.—Induration of the epidermis, and formation of square or angular prominences, not seated on a reddened surface.

VI. Tuberculæ.

Lepra Tuberculosa.—(Elephantiasis of the Greeks.)—Tubercles varying in size, preceded by erythema and increased sensibility of the skin, and followed by ulceration of their summits.

Lupus.—Induration or tubercular swelling of the skin, which may or may not ulcerate. In the former case, ulceration may occur at the summit or at the base of the tubercles, and frequently extends in the form of a circle more or less complete.

Molluscum.—Pedunculated, globular, or flattish tubercles, accompanied by no erythema or increased sensibility, occurring in groups. They are filled with atheromatous matter.

VII. Maculæ.

Lentigo or Freckle.—Brownish-yellow or fawn-coloured spots on the face, bosom, hands, or neck.

Ephelis.—Large patches of a yellowish-brown colour, accompanied by slight desquamation of the cuticle.

Nævi or Moles.—Spots of various colours and forms, sometimes elevated above the skin. They are congenital.

Purpura.—Red or claret-coloured spots or patches, which do not disappear under pressure of the finger.

VIII. Dermatozoa.

These minute animals require a lens of considerable power to ascertain their characters, which need not be particularised here, as they have been previously described and figured in the last lecture. (See p. 114, *et seq.*)

IX. Dermatophytæ.

These minute plants also require a high magnifying power to distinguish them. But they communicate peculiar characters to certain cutaneous diseases, as follows:—

Favus.—Bright yellow, umbilicated crusts, surrounding individual hairs, which agglomerate together to form an elevated friable crust, of a peculiar musty or mousey smell. (See pp. 112, 113.)

Mentagra.—Grayish or yellowish dry crusts, of irregular form, originating in the hair follicles of the beard.

In forming your diagnosis, therefore, you will be guided principally by three characters:—1st, The primitive and essential appearance—that is, whether a rash, vesicle, pustule, and so on. 2d, The crust,—whether laminated or prominent, composed of epidermis only, etc. 3d, Ulceration—whether present or absent; and if so, the kind of cicatrix. These and other characters I shall point out at the bedside, so as to familiarise you with their appearances.

You will remember that the classification formed by Willan is wholly artificial. It is like the Linnæan classification of plants. The difficulty for the learner is to recognise the essential character, the more so as many diseases pass through various stages before this is formed. Thus herpes presents, 1st, a rash; 2d, papules; 3d, vesicles; 4th, pustules; yet the disease is considered vesicular. Ecthyma passes through the same stages, yet it is considered pustular.

In the vesicular disease, however, the crust is laminated,—in the pustular, it is more or less prominent.

Again, it not unfrequently happens that two or more diseases are combined together in one eruption. Thus it is very common to meet eczema and impetigo combined, when the disease is called *Eczema-Impetiginodes*. Favus occasionally causes considerable irritation, producing a pustular or impetiginous margin around it. The vesicles of scabies are often accompanied by the pustules of ecthyma, and so on.

In very chronic skin diseases, it may happen that it is impossible to say what the original disorder was, whether vesicular, pustular, scaly, or papular. In such cases the skin assumes a red colour, the dermis is thickened, the epidermis rough and indurated, and a morbid state is occasioned, in which all trace of the original disease is lost, and what remains is a condition common to various disorders.

As regards varieties, little need be said, and as formerly stated, I advise you to postpone their study until you are acquainted with the diseases themselves. Even then an acquaintance with them is of secondary importance. These varieties have been formed on account of the most varied circumstances, such as,—1st, Duration, most of them may be *acute* or *chronic;* 2d, Obstinacy, hence the terms *fugax, inveterata, agrius*, etc.; 3d, Intensity, hence the terms *mitis, maligna*, etc.; 4th, Situation, hence the terms *capitis, facialis, labialis, palmaris*, etc.; 5th, Form, hence the terms *circinatus, scutulata, iris, gyrata, larvalis, figurata, tuberosa, guttata*, etc.; 6th, Constitution, hence the terms *cachectica, scorbutica, syphilitica*, etc.; 7th, Age, hence the terms *infantilis, senilis*, etc.; 8th, Colour, hence the terms *album, nigrum, rubrum, versicolor*, etc.; 9th, Density, hence the terms *sparsa, diffusa, concentricus*, etc.; 10th, Feel, hence the terms *læve, indurata;* 11th, Sensation produced, hence the terms *formicans, pruritus, urticans*, etc.; 12th, Geographical distribution, hence the terms *tropicus, Ægyptiana, Norwegiana*, etc.

Notwithstanding I have endeavoured to place this subject before you in as simple and uncomplicated a form as possible, I am conscious that at first you will still experience considerable difficulty in the diagnosis of skin affections. This can only be removed by practical experience at the bed-side, and by constantly exercising your powers of observation in detecting the essential elements which their varied forms present. At the same time, I think the modified classification and short characters I have given, will materially assist your studies in this important department of practical medicine. It must be remembered, however, that they only refer to those cutaneous diseases which you are liable to meet with in this country. Should you ever be called upon to practise in the tropics, or in other places where peculiar skin disorders prevail, it will, of course, be your duty to study them in an especial manner. Here, as they cannot be made the subject of clinical observation, they are altogether removed from our consideration.

FINIS.

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